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and

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Standard Cast Irons

A leading article in a recent issue of our contemporary, "The Automobile Engineer," on the subject of standard steels served to draw our attention to this same question in relation to cast irons, more particularly the alloy cast irons. In dealing with the subject of standard steels from the point of view of the automobile engineer, the article referred to urges the need for a concerted effort to use steels of standard specification. It is recognised from a development point of view that there is much to be said for trying out novel or experimental steels, but it is clear that the commercial use of many differing non-standard steels must inevitably lead to higher costs and higher prices in the resultant standardised products. The suggestion is that the American motor-vehicle engineers give greater support to their standardised products, and that in comparison with the corresponding British industry the American list of standardised steels is relatively much smaller. It is said that British designers demand non-standard steels numbering over two hundred specifications. Apart from the need for a greater effort to use standard steels, it is suggested that these later may be reduced in number with advantage, even if this entailed greater ingenuity on the part of designers and a first approach to design problems had to be made. In any case there is little doubt that in a national emergency only the simplest standard materials would be available for ordinary industrial purposes, and the closer standardisation, and the stricter adherence to such standards, might be regarded as a sound preparatory measure.

The case of cast iron is somewhat different, although there are those who perceive, in the introduction during the last few years of high-duty and alloyed cast irons, developments on lines parallel to those of the steel industry. In the case of what might be described as the ordinary grades of cast iron, the specifications required to be met are comparatively simple and really few in number, and whilst among individual founders there may be a wide variety of ways and means of meeting these specification requirements, this situation is not one which is likely to cause any embarrassment. In the case of high-duty or special cast irons, including the alloy cast irons, the list both of specification requirements and variety of materials is rapidly growing, and if the specification is defined as including composition in addition to requirements as to mechanical and physical properties, then it can be truly said that the list is already a large one.

The need for certain variations in the composition, particularly silicon content, to accommodate varying sectional thicknesses in castings is a complication in the case of cast irons which does not arise in the case of steels. Variations in composition for this purpose do, of course, account for a section of the large list of high-duty and alloy cast iron specifications in existence to day. Apart from considerations of this nature in the ranges of alloy cast irons, there are numerous specifications involving a wide range of alloy additions and combinations. For example, in what might be regarded as the simpler alloy cast irons in which additions of the elements nickel, chromium and molybdenum are concerned, the number of different preferred combinations of these elements is large, and it is doubtful if many of them serve any really useful purpose. It is probably true to say that if some attempt were made by an authoritative body to standardise the amounts and useful combinations of these elements in this field, the result would be one of very great value and would have a profound effect upon the development of this section of the industry.

In the richer alloyed cast irons there are the nickel and nickel-chromium compositions of the martensitic class and also the austenitic cast irons. From the point of view of alloy content only, these specifications are not yet numerous, but numbers show signs of growth through the introduction of modifications, with the object of securing improvement in properties in one or another direction. Of course, the high-duty and alloy cast-iron industry is of much more recent origin than the special steel industry, and it can well be urged that the knowledge of the whole range of properties of many of the special cast irons is not yet sufficiently developed to warrant standardisation. This is particularly true in the case of the richer alloy cast irons. In spite of this, the possibility of standardisation is one which should be watched closely by the various technical and research associations, and indeed the industry as a whole. Standardisation, if and when it becomes possible, will not only affect costs of production, but will make it easier to ensure the value of these special cast irons becoming more widely known, thus increasing the confidence of the engineer, who is the user of these products.

D

A New Research Laboratory

Wild-Barfield Electric Furnaces, Limited, of Elecfurn Works, North Road, Holloway, London, N.7, have recently equipped an extensive research department. The top floor is divided into two main sections to undertake metallurgical testing and chemical analysis.

Metallurgical Testing.—This department is equipped with a Vickers pyramid hardness testing machine of the latest type; a Hounsfield Tensometer testing machine, capable of carrying out the following standard tests:—Tensile test, notched bar test, slow bend test, compression tests, and cupping, punch sheet and Brinell hardness; and a Hounsfield balanced impact machine.

A special bench is set aside for the grinding and polishing of samples for photomicrography and is equipped with one of the latest types of polishing machines, by E. W. Jackson & Son, Limited, of Doncaster. The equipment comprises all the necessary polishing media for the preparation of both ferrous and non-ferrous samples for microscopical examination.

The balance room is housed in the metallurgical testing department, and in every way conforms to the latest type of room for such instruments. It is equipped with an Oertling balance, as well as a standard chemical balance of the ordinary type for less accurate weighings. Standard physical measurements such as barometric height, room temperature, etc., are taken daily in the balance room.

Optical Dark Room

An optical dark room is set apart for general microscopical work, photomicrography, and qualitative and quantitative spectrographic analysis. It is equipped with all the necessary apparatus for these processes and comprises, *inter alia*, a Vickers projection microscope of the latest type, fitted with both the standard Point-o-lite and the carbon-arc methods of illumination. The instrument is of the inverted pattern, and the stage upon which the specimen rests is capable of rotation and traversing movements and is mounted upon a heavy cast-iron stage support. The latter engages with the main body block by means of machined guide ways and is elevated or depressed by the action of the coarse focussing adjustment which is controlled by a helical rack and pinion movement actuated by a large milled head. The close engagement of the working faces between the stage support and the body block is ensured by the clamping spring and locking screw, which allows exceptionally heavy specimens (if necessary up to 50 lbs. in weight) to be placed on the stage without risk of the latter moving.

The second major item of apparatus is a Browning Spectroscope, which comprises a collimator tube fitted with slit arrangement capable of extremely fine adjustment; the table containing the two prisms and the usual telescopic arrangement for focussing are used for spectroscopic examination of metals and alloys. The metals or alloys to be examined are used in the form of rods in the standard type of arc holder, the electrodes being fed by d.c. current at 110 volts, from an a.c. supply through a rectifier, resistance and choke. This instrument is used not only for the qualitative analysis of alloys but also for their approximate quantitative analysis.

Chemical Laboratory

The chemical research laboratory is fitted out with the following furnaces of Wild-Barfield construction:—

Solder Bolt Heater.—For the purpose specified, and for general heating duty.

Laboratory Muffle Furnace.—This furnace is a rectangular type, and is for general purpose work being used up to temperatures of 1,000 deg. C.

Small Tubular Muffle Furnaces.—A single tube muffle and a double tube muffle furnace are in use for general chemical and metallurgical analysis, *e.g.*, carbon combustion, etc.

The three last-mentioned furnaces are hand-controlled by means of the ordinary type of resistance, and temperatures are indicated on a Foster multipoint pyrometer, with dual scale for both base metal and platinum metal thermocouples, provision being made for 12 station measurements.

Oven.—This is an electrically-heated oven for use in general chemical analysis and is capable of reaching temperatures in the region of 200 deg. C.; thermostatic control is incorporated.

Other electrical equipment comprises hot plates and an electrically-heated still for the production of distilled water. This latter plant is capable of giving up to six pints of distilled water per hour.

The analytical bench comprises the most recent type of laboratory fitting with the central portion of the bench allocated for volumetric analysis, being of construction to take aspirators containing standard solutions, burettes, etc. This portion of the bench is white tiled, and contains a central sink with the usual 3-point tap fittings. On either side of the titration bench is the standard laboratory bench fitted with red tiles which are acid and heat resistant. The reagent shelves are affixed to the wall at the back of this bench. At the extreme end of the analytical bench is a large fume cupboard fitted with a stainless steel exhausting fan and special asbestos piping for the removal of noxious fumes. This bench is well fitted with cupboards and racks taking a large proportion of the chemical equipment required for the class of work undertaken.

On the furnace bench opposite to the analytical bench, the furnaces previously mentioned are accommodated. Each furnace is wired up through its resistance to wall plugs, each furnace and resistance being so arranged that they can be moved from place to place at will. A portion of this bench is allocated for glass blowing, being fitted with all the necessary equipment—blow-pipes, glass-blowing tools, etc., for doing this work. A good supply of glass tube and rod of all varieties is carried to enable apparatus to be assembled and built up with the minimum of delay. Furthermore, this bench has attached to it the various cylinders of compressed gases likely to be used in metallurgical and chemical analysis.

The central benches comprise two long tables of a standard laboratory pattern, but are not fitted with any of the normal services. They are used for general and clerical work. The laboratory, as well as the metallurgical testing section, is fitted with the usual services, namely power points; compressed air at pressures between 80 lbs. and 2 lbs. per sq. in.; coal gas; boiling water, etc. The service points are arranged on the various benches so as to be easy of access and in the positions most likely to be used for the particular work in hand.

The laboratory is well illuminated by roof lighting on either side, and is also equipped with the latest type of electric light fittings for use in chemical laboratories. Furthermore, it complies with the accepted modern standards regarding safety, being provided with fire buckets, extinguishers, gas masks, first-aid cabinets, etc.

From the foregoing description of the metallurgical and chemical sections, it will be appreciated that they conform in every way to the best standards for research and development work, and are well equipped to enable the firm to carry out thorough investigations for customers, or in collaboration with their own laboratories or their technical staffs and advisers. Heat-treatment work is usually carried out in the demonstration shop situated on the same premises, and the work can be examined before and after treatment. It is standard practice to issue a regulation heat-treatment record, and test sheet, which give the very fullest particulars concerning the heat-treatment carried out and the results obtained.

Random Shots

Last Sunday the Lancastria Club held its thirteenth Annual Banquet. It is well known that this club was formed during the voyage of foundrymen to the American Foundry Exhibition at Detroit in 1926. On that voyage, apparently, they met with a good sample of Atlantic bad weather, but it is quite obvious that they do not meet once a year to wail in concert over the many personal discomforts suffered at that time, but to cement the good friendships formed.

* * *

At this time, when everything must be done to promote and maintain good relationships between the European peoples, this small club has a very special mission, for it has something like thirteen different nationalities amongst its members. This year's function welcomed several sons and daughters of the original members, and from the point of view alone of creating a good international feeling amongst a new generation, the continuance of the club is very well worth while. Mr. Frank Russell, its chairman, must indeed be congratulated for his tireless efforts in keeping together so successfully that little band of international friends.

* * *

The dinner was held in the Pinafore Suite at the Savoy Hotel, and Dr. Guido Vanzetti caused much amusement, besides displaying his versatility in the English language, by inquiring for the Petticoat Room!

* * *

Amongst the many reminiscences laughed over during the evening, Mr. Primrose told the story of the consternation which was caused in a Liége hotel during a Belgian conference when the accommodation engaged for "Mr. and Mrs. Primrose & Son" was found to consist of one room with a crib in it. Mr. Primrose's young hopeful was even at that time over six feet tall!

* * *

Liverpool Cathedral is to have the distinction of possessing the heaviest ringing peal of beals in the world. One of the bells, weighing 4 tons, is already about to be cast at the Whitechapel Foundry. Later the same foundry will cast another, weighing 14½ tons, which will run a close second in weight to "Great Paul" of St. Paul's Cathedral. The Whitechapel Foundry was making bells as early as 1538, and one cast in that year is still being rung in Westminster Abbey. Amongst its treasured records is the original order, dated 1709, for the "Great Tom" of Wren's cathedral. This bell is still in use as a mourning bell and was last tolled on the occasion of the death of Queen Maud of Norway.

* * *

There is in Lavenham, a medieval village in Suffolk, a most magnificent church with an equally magnificent peal of bells. The tenor is reputed to be one of the finest toned bells in England, and tradition has it that its marvellous tone is due to the addition of silver and gold to the usual metal. Lavenham in those days was a prosperous textile centre, and no doubt some of its wool-staplers had silver and gold enough and to spare. This particular bell celebrates its birthday on June 21, and is now over 300 years old, for it bears the inscription "Miles Graye made me 1625."

* * *

Talking of bells, congratulations must go to Mr. and Mrs. J. Bell, of Gateshead, who have recently been presented with a peal of three. One hopes, for their mother's sake, that their voices are as nicely graduated in tone as Liverpool's new peal will be, and, unlike most church bells, they will be mercifully silent on a Sunday morning!

"MARKSMAN."

Foundry Drying and Modern Coreshop Layout*

By W. H. SMITH

It is obvious that any method which reduces the period a job occupies space in the foundry, increases the shop output capacity to the same extent, quite apart from saving in wages paid on the job. Thus, the overhead charges on any job may be reckoned mainly by the number of hours it occupies productive shop space to the exclusion of other work; hence, every hour saved means extra tonnage output capacity for the shop per week, month or year.

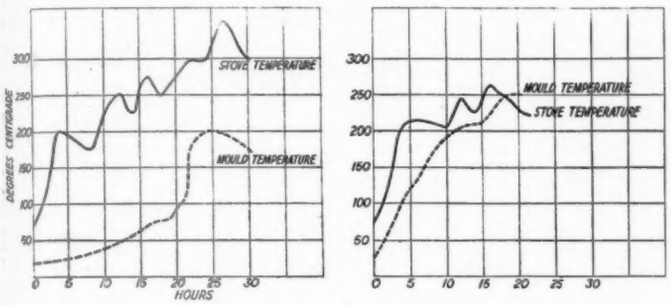

FIG. 1.—COMPARISON OF STOVE AND MOULD TEMPERATURES.
LEFT: WITH NATURAL DRAFT. RIGHT: ACME FORCED DRAFT.

Mould Drying

Very large moulds, made in the floor, or built up in loam and brickwork on the floor, cannot be put into stoves, and have to be dried in position. The old-fashioned method of drying moulds made in the foundry floor by means of fire buckets or braziers is very unsatisfactory and expensive. In the case of one foundry in Lancashire, only a year or two ago large moulds were dried by this time-honoured method. There were three braziers in the mould, and no less than ten fire buckets under the top. It was stated that the mould took four days to dry, and that one day was insufficient for drying the top. This firm now dries the complete job with one small-size mould dryer in 12 hours.

FIG. 3.—STOVE FURNACE.
(Courtesy Mather & Platt, Limited.)

For many years it has been a personal conviction that efficiency in drying depends on driving large volumes of air at moderate temperature, and at slight pressure, through the moulds or cores rather than the mere raising of stove temperature. The author has received graphs (Fig. 1) illustrating this point in a very marked degree, although the records were not taken specially for that purpose, but as part of a series of general efficiency tests, in a large steel foundry. Both graphs were taken on the same stove, under similar conditions, the only difference being the substitution of the natural-draft furnace for an Acme forced-draft type, which is literally pressure drying. Drying times in both cases could be improved if the furnaces were fixed direct on the stove. In this instance there is about 12 ft. of underground flue, and two bends between furnace and stove. If one examines the stove temperature range over the first 15 hours, there is very little difference. The mould temperatures, however, show quite a different condition. Note also the high maximum stove temperature with natural draft.

Mould and stove temperatures are both recorded on the same chart, one thermocouple being suspended in the stove, and the other embedded in the sand mould inside the stove. The speed at which the mould temperature follows that of the stove with pressure drying is worthy of note, as is the fact that the mould temperature eventually overtakes the stove temperature, due to speedy removal of humidity in the stove atmosphere through allowing water to escape from sand moulds.

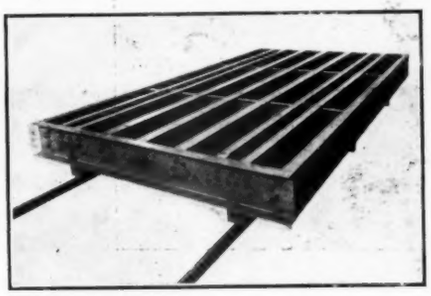

FIG. 4.—AN 80-TON FRICTIONLESS BOGIE FOR LOADING MOULD DRYING STOVES.

The following extracts from a Paper presented by Mr. Jasper Willsea at the American foundrymen's convention in May of this year throw additional light on this subject:—

"*Stalling the Baking with Wet Oven Air.*—If the oven air is allowed to become filled with moisture, the drying becomes slower and slower, and then stops, regardless of the oven temperature.

"*Ideal for Economical Drying.*—After being saturated at 100 deg. C., the air which has been close to a core is pushed out of the oven at once. The incoming air forces out of the oven all used, undesirable air and prevents any delay which is the most costly thing in core baking."

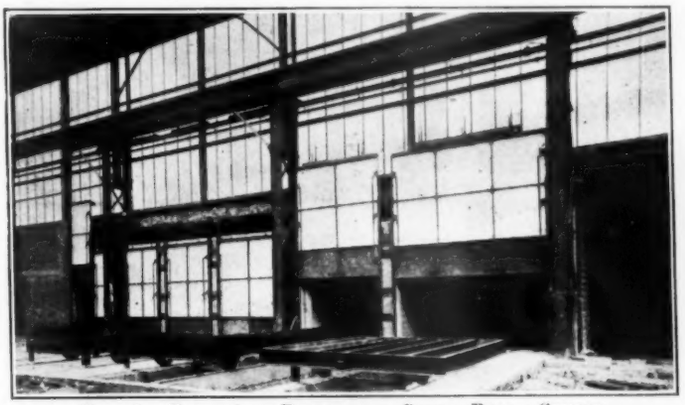

FIG. 2.—PART OF A BATTERY OF SEVEN BRICK STOVES.
(Courtesy Mather & Platt, Limited.)

There are at least three firms in this country building forced-draft stove furnaces of the type referred to. Fuel consumption with forced-draft furnaces, in relation to the weight of moulds dried, varies according to the size of stoves and conditions of working, but under favourable circumstances 40 lbs. of sand can be dried per pound of coke consumed. In one instance 46 lbs. of sand per pound of coke has been recorded.

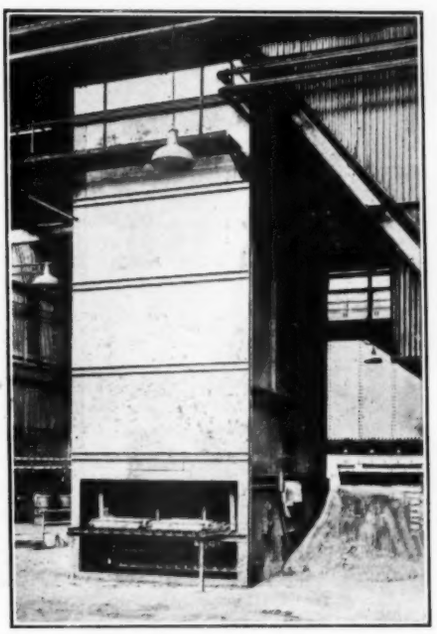

FIG. 5.—AUTO-LOADING STOVE.
(Courtesy Morris Motors, Limited.)

Figs. 2 and 3 show a battery of seven brick-built Acme stoves, all fired from a single furnace, and fitted with frictionless bogies for running loads in and out of stoves, and the actual furnace operating these stoves.

The frictionless bogies operate satisfactorily, without power tackle, although the temperature

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* Abstracted from a Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. H. V. Grundy presiding.

when forcing up with the "short-period" type furnace is sometimes sufficient to burn the back of the steel frames. Twenty-tons load is quite an ordinary capacity for modern frictionless bogies. A 30-ton size has been running in a large Sheffield steel foundry for nearly 12 months, and one of 80-tons capacity has recently been delivered to a large roll foundry. Fig. 4 shows a bogie, 18 ft. long by 10 ft. wide, which has six steel wheels 18-in. diameter. The main frame is of

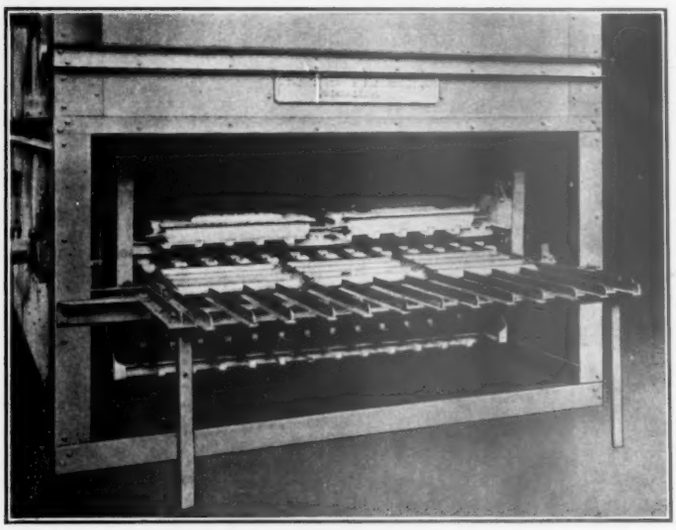

FIG. 6.—TRAY BEFORE UNLOADING.

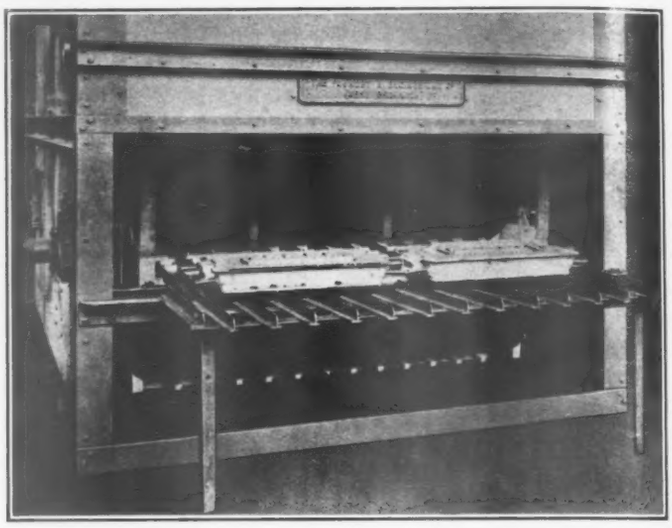

FIG. 7.—TRAY AFTER UNLOADING.

(*Courtesy Morris Motors, Limited.*)

15-in. deep channels, but the main load is carried on four 12-in. by 3½-in. channel bearers, the whole being braced so that the loading is distributed over the entire framework.

Core-Drying Developments

A further advance in the Acme continuous system of core drying has recently been made, and Morris Motors, Limited, were the first to adopt it. Figs. 5, 6 and 7 show respectively the

FIG. 9.—VIEW OF REARRANGED CORESHOP. (*Courtesy Ruston & Hornsby, Limited.*)

automatic loading and unloading of the stoves, a tray of moulds dried and just about to leave the stove, and the moulds just clear of the stove after being released by the tray.

One core-drying scheme was planned for working with one stove only, but owing to rapid increase of output a second stove had to be installed and a new lay-out arranged, giving increased working space and avoiding overlapping. It was effected by two large stoves, shown in Fig. 8, which are over 20 ft. high and 23 ft. long, being lifted and moved without dismantling. The chimneys, however, were disconnected. The one on the right of Fig. 8 was run down the foundry on rollers, the other turned the reverse way round, moved about 15 ft. up the shop, and the first then replaced alongside it. This feat was accomplished in 9 hours, and reflects great credit on the maintenance staff of Ruston & Hornsby, Limited, of Lincoln. This rearrangement made it possible to give over the whole coreshop to coremaking only, and Fig. 9 gives a good idea of the increased space made available. The green core conveyor is now on the right and collects from the far end of the shop.

Fig. 10 shows one of the newest and cleanest coreshops in the country. Everything possible has been done for the health and comfort of the workers, even to the provision of wireless programmes. The walls are of glazed bricks in two colours. There are two conveyor systems in this shop.

A steel band up the centre between rows of core benches delivers the cores to the large Acme continuous stove for drying, a pendulum conveyor forming a loop round the stove at the top, and passing the outer edges of core benches, while the sand-preparing plant at the bottom end of the shop collects mixed sand in buckets for delivery to the core benches, and returns the core plates on tray carriers from the unloading end of the stove.

The storage of dried cores is arranged at the far end of coreshop, and distribution in this section is assisted by a length of roller conveyor.

Fig. 11 shows a modern layout worthy of commendation, and adopted in a very large steel foundry for concentrating in one shop all its core production. The production entails the use of small cores weighing only ounces, with all intermediate sizes up to built-up loam cores weighing a ton or more. Sand preparation and mixing are performed on the ground floor, although there is much to be said for elevating and mixing overhead, and delivering to conveyor or carrier truck through hoppers in the floor above.

All mixed sand in this case is delivered to coremakers by electric platform truck, which also performs many other ancillary operations, including the taking of racks of heavy cores within reach of stove crane; collecting and distributing coreboxes, etc. The No. 1 and No. 2 sizes of cores are all dealt with by the continuous stoves and collected by the band conveyor. After drying, a similar band distributes the dried cores as necessary for inspection, jointing and blacking, and also takes them on for putting through a blacking drying stove, and afterwards into core-storage department.

The No. 3-size cores, which are too large for continuous drying but can be "manhandled," are made between the continuous section and the No. 4 section, where the heaviest loam cores are made under a light travelling crane. The No. 3-size cores are loaded on racks and conveyed by platform truck under the overhead traveller, which places the racks of cores, and

Captions to Figs. on opposite page

FIG. 8.—TWO LARGE CONTINUOUS CORE STOVES BEFORE REMOVAL TO A NEW SITE.
(*Courtesy Ruston & Hornsby, Limited.*)

FIG. 10.—GENERAL APPEARANCE OF THE NEW CORESHOP.
(*Courtesy British Thomson-Houston Company, Limited.*)

FIG. 12.—BRICK STOVES AND LARGE CORES.
(*Courtesy Hadfields, Limited.*)

FIG. 13.—GENERAL APPEARANCE OF A FRENCH FOUNDRY INCLUDING TWO ACME CONTINUOUS STOVES.
(*Courtesy Automobiles Berliet.*)

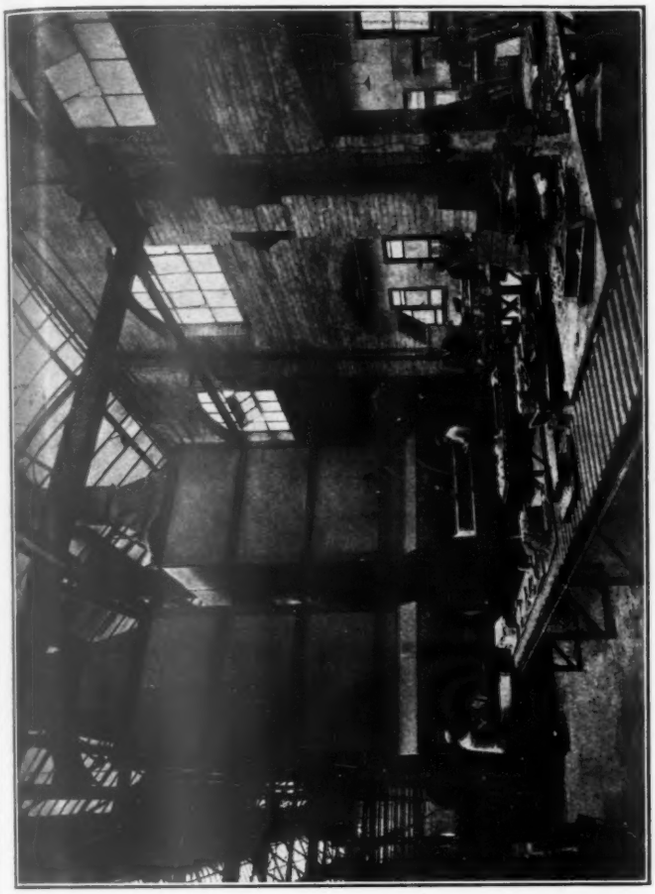

FIG. 8.

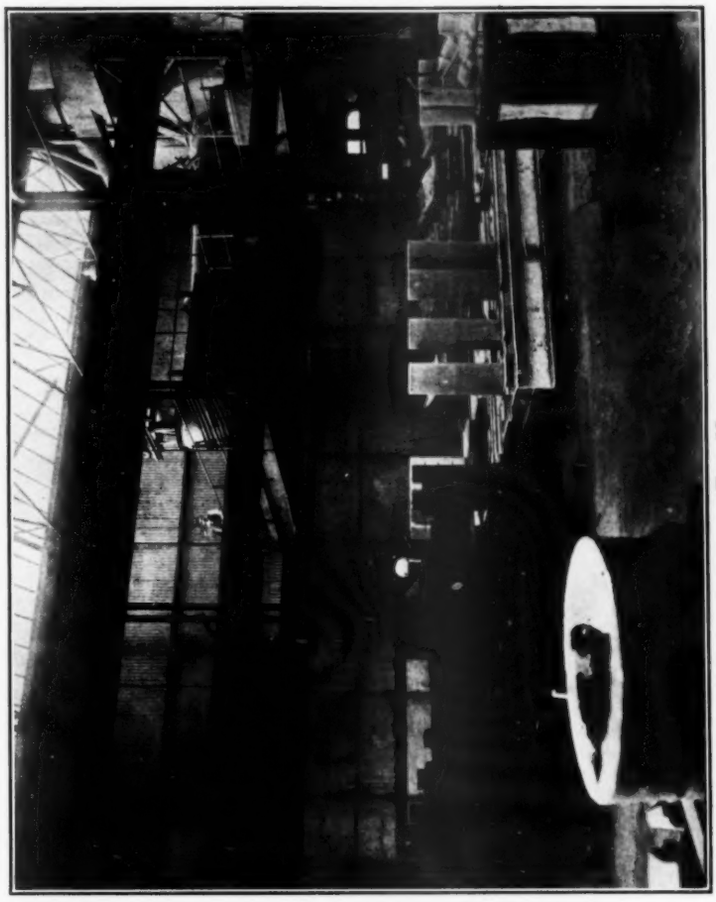

FIG. 12.

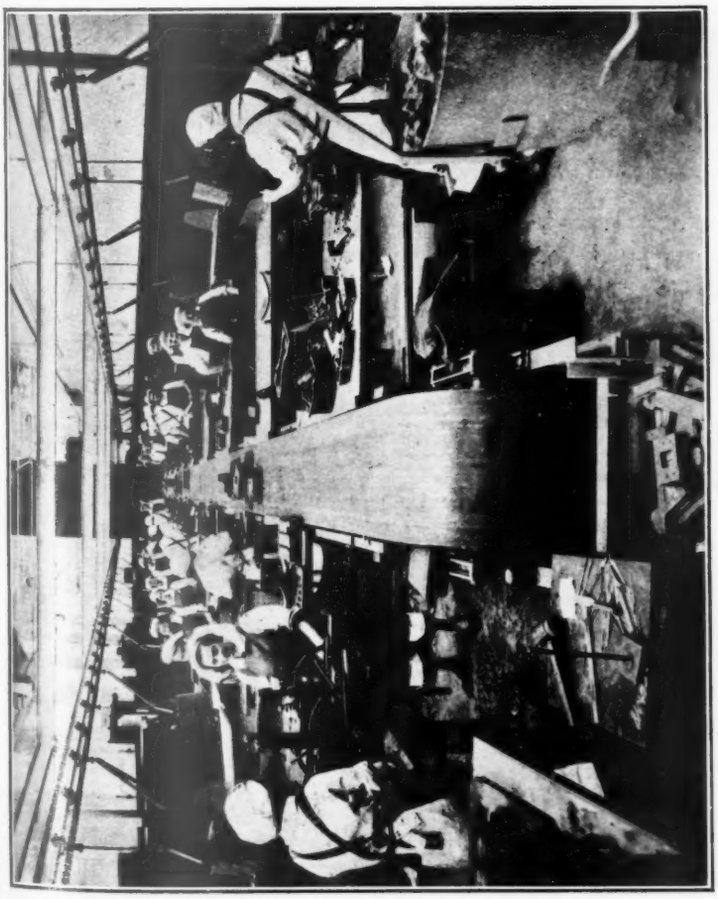

FIG. 10.

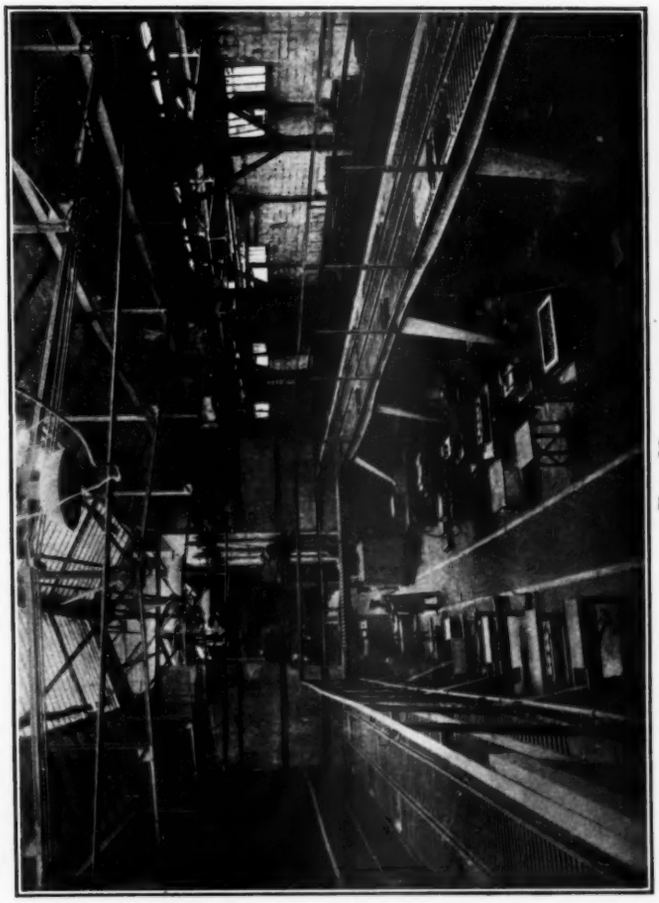

FIG. 13.

the heaviest cores (No. 4) as made, on frictionless bogies for stoving in modern forced-draft brick stoves.

The platform truck takes all cores after drying, in bulk as far as convenient, through the foundry, where the main cranes distribute them to their respective moulds. If it be desired to use girl labour for the smaller cores, and men for the heavy, it is quite easy to divide off the girls' coremaking section from all other parts, and still concentrate all coremaking in one main shop. Fig. 12 shows the production and drying of the larger cores. The sand preparation in this foundry is carried out overhead, which is quite a good arrangement.

A French Installation

Fig. 13 shows two Acme continuous stoves working in a large French motor-vehicle foundry. The coreshop layout is not yet completed, although the first portion of the scheme was put into work 12 months ago. The overhead platforms are a continuation of the stage on which the core sand is prepared, delivery being made to core machines and benches via the hoppers shown. Both jolt and hand turnover machines are used for the larger cores, the plate conveyor on the right of Fig. 13 delivering to the stove.

Three Coleman core blowers produce most of the small cores, others being made on benches by girls. A pendulum-type conveyor delivers these cores to the second stove.

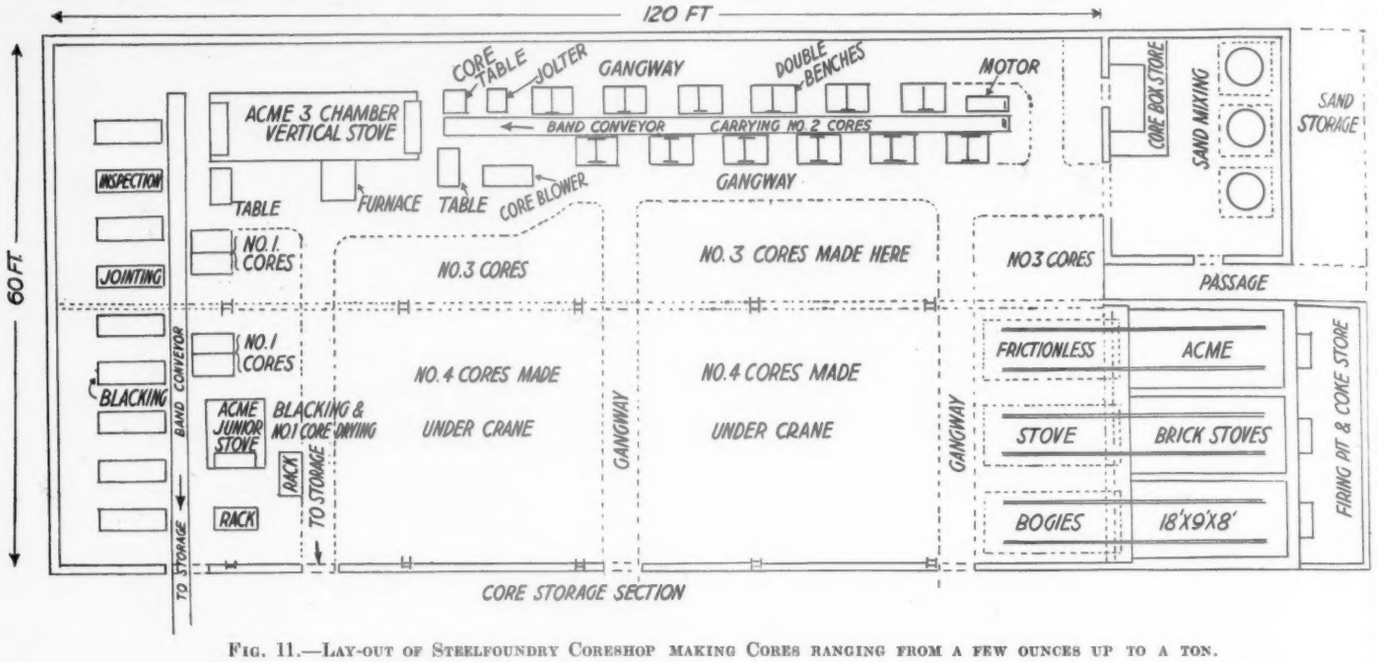

FIG. 11.—LAY-OUT OF STEELFOUNDRY CORESHOP MAKING CORES RANGING FROM A FEW OUNCES UP TO A TON.

Fig. 14 shows the layout of the proposed coreshop when completed. It provides (*a*) additional core making and drying for small cores, on a subsidiary conveyor loop system; (*b*) inspection and blacking facilities for all cores; (*c*) alternative routing after blacking, either direct to assembly or *via* the blacking drying stove, and (*d*) assembly, final inspection and loading on stillage racks for delivery to foundry as required.

The top right-hand corner of Fig. 14 shows core benches (1) and a core blower for making small cores, a roller or pendulum conveyor feeding from the benches to a "Junior" type continuous stove and also collecting dried cores, which are inspected and blacked on the benches in the section marked (2). Core sand for this section can be supplied from the existing overhead platform system. At point (4) all finished cores are transferred to the main pendulum conveyor system, and travel right on to assembly and storage.

At point (8) the main conveyor collects all dried cores from the two large continuous stoves, with the exception of the large cores which do not require stoving after blacking. These travel by route (11) for inspection and blacking and direct to assembly without passing the blacking stove. Section (9) comprises roller tables and spray booths from which cores are taken to the stoving and on by two alternative conveyor lines for assembly and final inspection before loading on racks. A passageway for an electric lifting truck is maintained from the foundry right round the core finishing section.

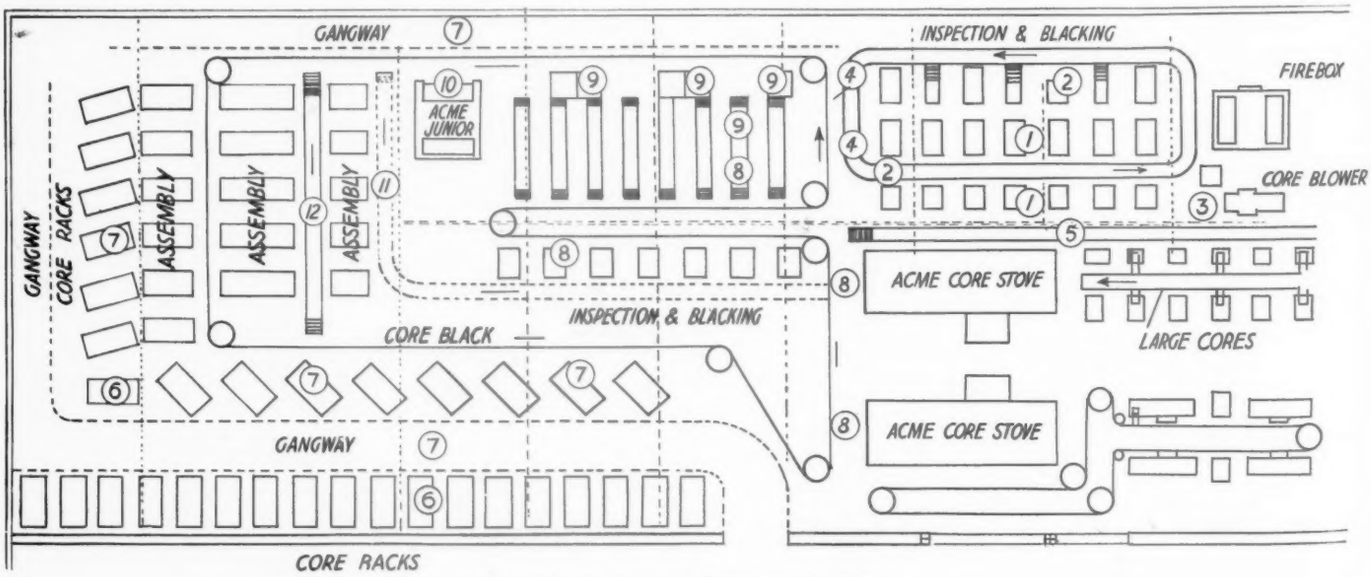

FIG. 14.—LAY-OUT OF PROPOSED CORESHOP.

In conclusion, the author expresses his thanks to Augusts, Limited, and Pneulec, Limited, for the loan of slides and to the many firms who have given assistance or facilities for obtaining the illustrations shown.

South African Foundrymen's Problems

SOLUTIONS EXPLAINED AND SUGGESTED

A series of short Papers presented at a recent meeting of the South African Branch of the Institute of British Foundrymen, held in Johannesburg, dealt with a few of the problems which are experienced by the members in everyday practice. The programme was arranged by the Papers' Committee of the Branch, and Mr. A. H. Guy (Branch-President), in expressing the hope that all the members would take part in the discussion, appealed to executives to allow the younger men some freedom to experiment on new ideas.

The Papers and the discussion on each are reproduced below.

ROPE PULLEYS

By D. LION-CACHET.

Specifications which the mining houses and the Government issue have attached to their orders a notice reading: "All castings must be free from blow-holes, draws, scabs, and all other imperfections." This sentence includes almost all the troubles of the foundryman. Unfortunately, the specifications do not state how to avoid these imperfections in castings. The particular difficulty to be dealt with is that of drawing with special reference to the manufacture of V-rope pulleys.

The smaller pulleys up to about 24 in. give very little difficulty. Usually the design does not matter very much, and the foundryman simply casts a plate centre with or without holes as he sees fit, or, when the need arises, with very large holes, which give the pulley the appearance of having spokes, and the job is quite satisfactory. There is little difficulty experienced in casting the rims of a good close-grained homogeneous metal. As soon as the pulleys become larger the need for spokes, and in many cases curved spokes, arises. It is often found, when machining these pulleys with spokes, that there is a "cavity" formed in the rim just where the spokes join, as shown in Fig. 1.

One can hardly call it a "cavity." Rather a portion of the casting is formed of very open-grained iron. This fault usually only shows up at the final machining, when the time and money already spent on the defective article is nearly equal to the tender price minus a doubtful profit. The only certain method of rectifying this fault is to scrap the casting and to start afresh, incurring the same risks as before. After several such failures a start was made to experiment seriously. It was definitely possible to cast good ones, because every now and then successful ones were made.

First Trial.—A chill was rammed in the mould exactly opposite each spoke for the purpose of chilling the metal and so preventing the formation of shrinkage cavities. This made some difference, but the setting of the chills was a tedious affair and great accuracy was required of the moulders. Further, it had the effect of hardening the casting, and complaints came from the machine shop.

Second Trial.—Two chills for each spoke were placed at the inside of the rim, and were put in the core box prior to making the cores in order to embed them firmly, as shown in Fig. 2. The disadvantage of this method was that, owing to the lack of uniformity in size of the pulleys, separate chills had to be made for each job. Also, it had the tendency to render the spokes brittle, resulting in frequent breakages during the cooling process. These disadvantages did not compensate for the absence of cavities.

Third Trial.—Large nails were inserted halfway in the cores in such a manner that the heads were in the place where the cavity occurred. This had also a chilling effect. But whenever the metal was a little dull the machine shop kept on finding nails in the bottom of the grooves after machining, because no proper fusion had taken place. This method was too uncertain and had to be discarded.

The very large wheels did not give so much trouble, because it was possible to cast the groove and leave sufficient metal for machining. The result was that the porous parts were not exposed. The moulders disliked the job intensely, because the setting of the cores forming the grooves caused a great deal of trouble, and they were never sure whether the job was satisfactory until it had been machined properly. The advantage in having less metal to cut away is not great nowadays. Since the tungsten-carbide tools have come on the market the cutting away of metal does not weigh up against the extra time spent in the foundry. Therefore, the coring of the grooves was also abandoned.

Fourth Trial.—This was an improvement on previous trials. A small ball was cast on the head of a 6-in. nail, and this was placed in

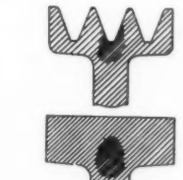

FIG 1

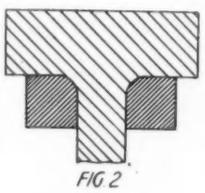

FIG 2

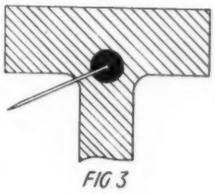

FIG 3

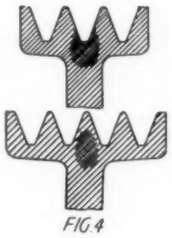

FIG 4

such a position that the grey-iron ball was in the place where the fault occurred (Fig. 3). This arrangement was successful; the machine-shop did not complain as long as the size of the ball was chosen carefully relative to the size of the rim section, and the casting temperature was correct. There was sufficient chilling effect to prevent formation of cavities but not enough to cause troubles in the machining.

Yet the job was not right, and difficulties kept cropping up. The chief of these was the determination of the size of ball required without resorting to endless experimentation. Some wheels were perfect, others not, until it was discovered that the good castings were always those with an even number of grooves, and the castings that had to be discarded were always those with an uneven number of grooves. The reason of course, was that the *dividing wall* between the grooves in the even number was on top of the spoke, and in the uneven number the *groove* was on top of the spoke, leaving the cavity exposed, as shown in Fig. 4.

The wheels with the even number of grooves had the same defect but it was not detrimental to the job, because it did not expose the cavity. The solution was obvious and simplicity itself. In cases where an uneven number of grooves was specified the patternmaker moved the spoke under the dividing wall. Those specified with an even number were left severely alone. The result is that the number of rejects has dropped from 15 per cent. to 0.5 per cent.

DISCUSSION

MR. TONGE said that the mention made of cold iron at times seemed to suggest more careful cupola control. He thought that careful control of the metal temperatures and the application of the method shown would probably correct difficulty.

MR. BRAGG thought that the figures indicated the design of the wheel to be at fault. In his experience it was found that two rows of spokes in the wheel near the edges of the casting instead of a single row of spokes near the centre of the casting usually corrected the fault complained of.

MR. LION-CACHET pointed out that most pulleys were made to the customer's drawings, which had to be adhered to. To design pulleys as well as tender on them would be both tedious and costly.

MR. TONGE suggested that the discussion indicated that closer co-operation between the foundryman and the engineer was desirable.

CAST-IRON PIPES

MR. MORRISON gave a very interesting and humorous talk on some cast-iron pipes which his firm had to make. There were some 200 pipe castings which had to withstand a hydraulic test of 350 lbs. per sq. in. The long pipes were cast in loam and looked first-class when removed from the floor. The first 14 castings were passed by the inspector, but some bends showed signs of leaking at the chaplet. Then the duckfoot bends gave trouble under test, but the worst trouble was experienced on some of the pipes having Kimberley joint spigots; the metal on these pipes changed in thickness from $\frac{3}{4}$ to $1\frac{1}{4}$ in. in a short distance and, when subject to test, failed. Mr. Morrison then went on to explain how the difficulties were overcome.

The CHAIRMAN thanked Mr. Morrison for his talk, and told a story of his experience with a chemical offered as cheaper and better than lime for use in pumping. The new chemical, although cheaper, corroded all the pipes, and the moral was that cheapness did not always pay.

MR. MORRISON reminded the meeting that the inspector who tested his pipes tested all the water used for testing.

TUBE-MILL TRUNNION LINERS

By H. HOLDSWORTH.

An order was placed for two tube-mill trunnion liners made in white iron. The first one was cast and on being checked was found to be $\frac{5}{16}$ in. too long, the diameter being correct. The pattern was measured and found to be correct, that is, it was to size with double iron contraction allowance, the standard used for this type of metal. Various theories were put forward—had the moulder taken adequate care?—had the pattern swelled? and so on. However, for safety $\frac{5}{16}$ in. was taken off the length of the second liner made. This was $\frac{3}{16}$ in. too long.

At a later date another was ordered, the pattern being the same as used for the second, and this came out exactly to length. The fact that the contraction variation only applies to the length, as the diameter contraction behaves in a normal manner, is strange. It is found that this phenomenon applies to all castings of this type. Castings have been made from 10 to 18 in. diameter, and 24 to 37 in. long, and allowances made accordingly, $\frac{1}{4}$ in. being the minimum. Another trick this casting will play if not controlled is that, when left to cool in the ordinary way, it is prone to tear. To remedy this the core was removed, but that in itself was not a sufficient cure, and the casting had to be freed entirely.

The system adopted is that, as soon as the metal is set, the top box is removed and the boxes tipped on their sides at the bottom joint, leaving both ends free for access with bars for the removal of the sand. It is not left until it is absolutely free. Incidentally, these castings are made in dry sand and cast on end.

DISCUSSION

MR. TONGE asked whether the cores on the first two castings were removed soon after casting.

MR. HOLDSWORTH said that the core on the second casting was partially removed. On the third casting, however, the casting was completely freed from the mould soon after casting. He indicated the tears which occurred in the first two castings.

MR. DAVIDSON suggested that the cores were made too hard.

MR. HOLDSWORTH explained that the cores were built up on a plate round a 9-in. pipe. The pipe was removed and the space filled with coke. The main difficulty experienced was the contraction on the casting measured lengthwise. The casting must be reasonably accurate as to dimensions, as they had no means of machining this hard material.

MR. SCORGIE said that from a patternmaker's point of view it was difficult to estimate the shrinkage of white iron.

MR. CORNTHWAITE was of the opinion that the silicon content was the cause of the variations in length, and MR. HOLDSWORTH agreed.

MR. GUY remarked that there were different kinds of white iron. He mentioned making some impellers, using metal of which tube-mill liners were usually cast. The impellers failed in use.

MR. DAVIDSON said that the "one-off" job was entirely different from "many-off" jobs in that control of heat and analysis was difficult in a general cast. He told how his firm, when making diaphragms for the V.F.P., had to divert slightly from the makers' design to make a successful job. When in England shortly afterwards, he approached the makers on the reason for his difficulty and was informed that the secret lay in the metal, which was specially alloyed to overcome troublesome shrinkage.

A PISTON TROUBLE

MR. HOLDSWORTH then read a short description of a casting for a piston, which showed small gas holes about 9 in. from the bottom. The piston was required 5 in. dia. by 18 in. long, and had to be of good-quality grey iron and free from defects. It was made in dry sand, the casting being 5¼ in. dia. by 25 in. long. On being machined, it was found to have several spherically shaped holes, which showed about 9 in. from the bottom when the first cut was removed. Fortunately, these defects machined out, but there was little reason for these gas holes, as the job was dried and cast on end.

SMALL PINIONS

MR. WALDECK gave a very interesting outline of the casting of small pinions which had given them some trouble. The pinions were mounted on a turn-over board and moulded by hand at first, but the resulting castings were not satisfactory, due to the difficulty in drawing the pattern. The ramming also gave trouble due to the fine pitch of the teeth. It was decided to use the jolt-rollover machine. The first bar made on the machine was not right, because the sand was not sufficiently rammed at the root of the teeth and the patterns did not draw well. A brass stripping plate was then made which fitted neatly over the pattern to hold the sand firmly while drawing the pattern. This improved the job somewhat. The sand was not yet firmly rammed at the root of the teeth. A small ramming plate was then made to supplement the jolt ramming. This solved the problem, no further trouble being experienced. In casting the first lot, the castings were run from the top and all had blowholes in them. They were then run from the bottom, and no further trouble was experienced.

DISCUSSION

MR. TONGE asked why the gears had not been made in core.

COL. GROSE said that he wanted to get away from core-making because of the cost, and they would have had the same difficulties as when moulding them.

Mr. Waldeck was asked to demonstrate the method of using the ramming plate, which was done.

MR. SIMPSON asked how long it took to mould a box containing six patterns, and in reply MR. WALDECK said that the floor to floor time was about five minutes.

TWO SIMPLE TESTS FOR MOULDING SANDS

BY J. CARTWRIGHT.

One of the troubles always to the fore in a foundry is the question of the correct mixing and reconditioning of moulding sand. Even from the same source sands tend to vary from time to time, both as regards the size of the granular particles and clay and hydrated iron oxide content, that is, if the sand is not entirely siliceous and some other bonding medium is employed. Apart from microscopic and chemical analysis, no definite specification of tests securing general acceptance has yet been formulated and the following descriptions of two sand tests may be of interest.

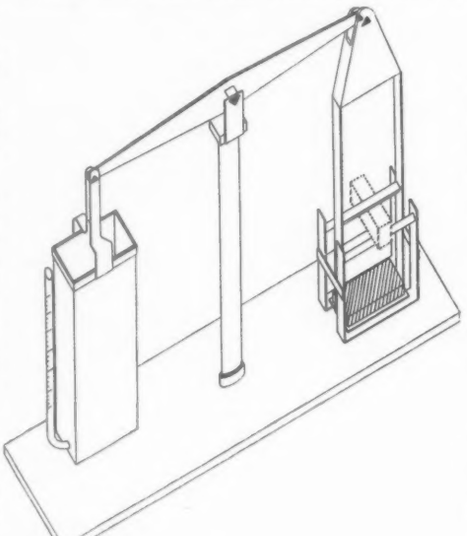

FIG. 5.

Some little time ago a foundry was experiencing trouble with the friability of sands in use after the drying of the moulds, and it was felt necessary to establish some quick method by which the bonding strength of different consignments and different mixtures of sand could be compared. To this end a beam of a balance was constructed, suspended in the middle by means of a knife-edge (Fig. 5). Suspended from one end of this beam is a lead weight which exactly balances a canister filled with water suspended from the other end. Attached to the supports carrying this lead weight is a knife-edge, edge downwards, and this is equidistant from two further stationary knife-edges, edges upwards, attached to the base of the balance frame. A core of each of the sands in question, each 4 in. long and ½ in. square, is made, and they are in turn placed across the two stationary knife-edges. Water is syphoned from the canister, and the mass of the lead weight gradually transferred by means of the central knife-edge to the centre of the sand core. The core will eventually break, and the water level is read off a graduated glass tube at the side of the canister. After a succession of experiments comparative figures are provided for bending strengths. The balance is also useful in determining the degree of ramming to which a sand should be subjected, and whether an artificial bonding medium need be employed.

The second test concerned the determination of the moisture content of a sand, and a description was given of the Speedy machine.

The PRESIDENT, closing the meeting, said it had been most successful, and he thanked the Papers' Committee for their work.

MR. ROBERTSON, on behalf of the Committee, said that the results were very encouraging, and he appealed to the members to co-operate by submitting their problems in writing, so that another meeting of similar character could be arranged. The Committee wished to thank Mr. Guy, the President, for a donation of £10 10s., which was to be used by the Papers Committee as they saw fit.

MR. NIMMO DEWAR expressed his pleasure that the second year of the Branch had started so well, and hoped that the progress would continue.

Lancastria Club

The thirteenth Annual Banquet of the Lancastria Club was held in the Pinafore Suite of the Savoy Hotel, London, last Sunday evening. It was presided over by its President, Mr. Frank S. Russell, F.R.S.A., who was accompanied by Mrs. Russell. Amongst a company of about 30, nine original members were present, including Dr. Guido Vanzetti (President of the International Foundrymen's Technical Committee) and Mrs. Vanzetti; Mr. and Mrs. W. Jolley; Mr. and Mrs. E. Longden; Mr. and Mrs. J. M. Primrose, and Signor Palliccotti. Amongst the guests were Mr. V. C. Faulkner (who was President of the Institute of British Foundrymen at the inception of the Club in 1926) and Mrs. Faulkner; Mr. and Mrs. Victor Seeley; Mr. and Mrs. G. V. Lohan; Mr. E. L. Dexter; Mr. D. W. Caldwell, and Miss D. G. S. Russell.

Apologies for absence were received from Mr. John Cameron and Mr. H. Winterton (both Past-Presidents of the Institute of British Foundrymen); Mr. W. B. Lake, J.P. (President-Elect of the Institute); Mr. H. D. Campbell; Mr. V. Delport. From France there were Mr. C. Primet, Mr. Paul Thomé, Mr. L. Montupet and Mr. H. Magdelenat; from Italy letters were read from Mr. G. Falck, Mr. A. Rocca, Count Franco Ratti, Mr. V. Galtarosso and Mr. A. Galtarosso; and from other countries were apologies from Dr. Korschan, of Essen; Mr. Paul Ropsy, of Antwerp; Miss Brons, of Holland, and Mrs. Gruson, of Munich.

In his address, MR. RUSSELL pointed with pride to the honours which the various countries had showered upon members of the Lancastria Club, an international group of foundrymen who were, because of the tempestuous weather, literally thrown together for ten days when crossing the Atlantic in the "Lancastria" to attend the Detroit international congress in 1926. Mr. Cameron, Mr. S. H. Russell and Mr. H. Winterton were all Past-Presidents of the Institute of British Foundrymen, and Mr. W. B. Lake was to be installed into that office next June. Then Mr. Paul Ropsy and Mr. V. Delport had been, and Dr. Vanzetti was, President of the Foundrymen's International Committee. Several others had also presided over their national technical institutes. Yet the main activity of the Club was the promotion of international good will, and he claimed that in this direction the Club had been particularly successful. Its members had found personal friends in most countries of Europe.

During the evening, an excellent musical and magical entertainment was provided, and very early on Monday morning Mr. Russell exhibited a coloured film of his recent tour through the United States of America.

Compression Strength and Shearing Strength of Moulding Sand*

By Prof. Eng. B. HOLMAN

The cohesion of moulding sand is determined by ascertaining the compression strength or shearing strength of test specimens. In the Institute of Foundry Research (Prof. Mont. Fr. Pisek) of the Dr. E. Benes Technical High School in Brno, comparison tests have been made in the laboratory for the purpose of ascertaining the method by which the value of moulding material could be estimated better and more in agreement with the experience acquired in the foundry. It was very soon found, however, that there was an invariable relationship between the results obtained by these two methods of testing, so that

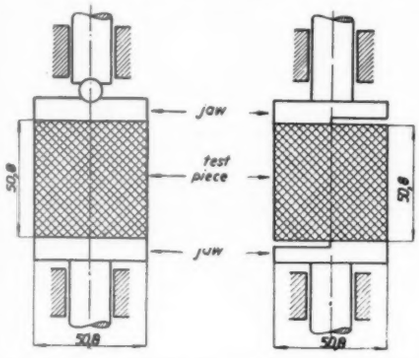

FIG. 1.—ARRANGEMENT OF JAWS FOR (LEFT) COMPRESSION TEST, AND (RIGHT) SHEARING TEST.

it was possible to calculate the results obtained by either of the two methods from the results obtained by the other method. The following is an account of this law, which was found to hold good for all the tests made.

Characteristics of Sands Investigated

Comparison tests were made with 14 sorts of moulding sand of widely varying qualities. Table I gives the particulars regarding their characteristic qualities, the sands being arranged according to the mean size of grain. (The method of qualifying the sand is the same as that employed in the Paper presented to the 1937 International Foundry Congress, Paris, by Pisek and the present author on "Relation between the Foundry Properties of Moulding Sands.")

TABLE I.—*Characteristic Properties of the Investigated Sands.*

Designation of sand.	Colour of sand.	Sieve tests. 1.0 mm. Per cent.	0.5 mm. Per cent.	0.2 mm. Per cent.	0.1 mm. Per cent.	0.05 mm. Per cent.	0.05+ 0.02 mm. Per cent.	Clayey matter.	Mean size of grains.	Dye adsorption.
2	White	—	0.1	3.6	32.3	37.6	18.0	8.4	0.074	2.1
6	White	—	0.6	12.6	14.8	21.0	35.1	15.9	0.059	3.1
9	Green	—	—	2.3	19.1	39.4	16.2	33.0	0.068	53.0
11	Yellow	—	—	10.7	21.5	31.6	22.6	13.6	0.069	—
48	Black	—	1.9	19.6	23.6	18.4	15.5	15.0	0.087	—
16	Yellow	—	—	0.7	46.8	20.5	8.5	23.5	0.092	42.0
17	Yellow	—	0.07	12.9	41.4	28.5	10.1	6.4	0.095	5.1
19	Ochre	—	2.3	13.3	37.9	24.5	9.7	12.3	0.098	10.7
24	White	—	—	30.2	29.0	20.2	4.7	15.9	0.123	3.7
26	Yellow	—	2.4	31.0	32.1	22.2	3.0	9.3	0.131	10.0
39	Green	—	11.2	50.9	22.5	3.2	1.6	10.6	0.224	20.0
42	Reddish-brown	5.8	18.3	50.0	8.2	3.9	1.8	12.0	0.268	19.7
43	Red	11.3	26.4	39.8	7.4	3.6	3.0	8.5	0.269	6.8
44	Yellow	8.7	51.5	32.6	1.5	0.7	0.7	4.3	0.462	2.5

Preparation of Samples

Six to eight samples of each sort of sand were taken, each sample weighing 6.6 lbs. The samples were then moistened with different amounts of water. Three or four samples were moistened for green sand moulding, two or three samples were moistened to a greater extent for stoving and one or two samples were moistened only very slightly. After mixing them thoroughly in a "Royer," 12 test-specimens were rammed from each sample in accordance with the specification of the American Foundrymen's Association. The specimens for testing the compression and the shearing strengths are identical in shape, being cylindrical and having a mean height of 2 in.

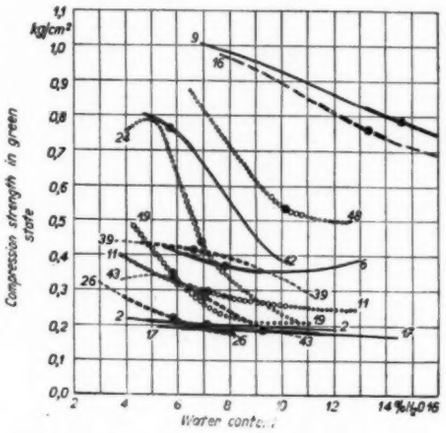

FIG. 2.—COHESION DETERMINED ON BASIS OF COMPRESSION STRENGTH IN GREEN STATE.

Actual Test:

Three specimens were employed in the green state for the cohesion test by determining the compression strength. The tests were made in the Adams apparatus. The other three specimens were used for the cohesion tests by determining the shearing strength in the Dietert balance beam apparatus (Type C.P. universal sand strength machine). Six test-specimens, after being rammed, were dried in an electric stove at a temperature of 150 deg. C. and then kept in a dessicator until the test was made. Three of these stoved test-specimens were subjected to a compression strength test in an apparatus designed for testing cast iron and constructed by the Losenhausen concern. The other three stoved specimens were employed for making a shearing strength test in the Dietert apparatus already referred to. In all, 800 specimens were tested.

The compression strength of the specimens of the same sample was expressed in kg. per sq. cm., the mean load in kilograms at which the specimens broke being divided by the horizontal sectional area of the specimen (20.3 sq. cm.).

The shearing strength of the specimens of the same sample was also expressed in kg. per sq. cm., the mean load in kilograms at which the specimen broke being divided by the axial sectional area of the specimen (258 sq. mm.).

The left half of Fig. 1 shows the jaws for the compression strength tests and the right half the jaws for the shearing strength tests. The sketches also indicate the guiding of the jaws in the test apparatus. Due to the method of organising the work while the tests were being made, it was possible to eliminate completely all sources of material and psychological errors.

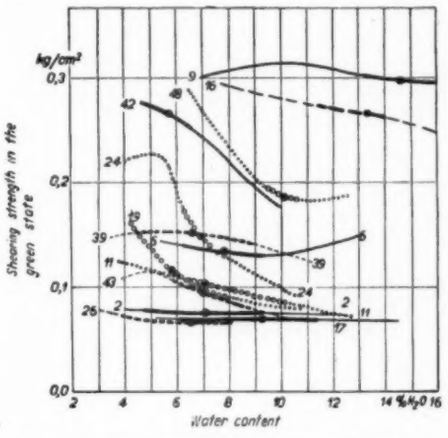

FIG. 3.—COHESION DETERMINED ON BASIS OF COMPRESSION STRENGTH OF STOVED SPECIMENS.

For the purposes of an exact comparison of the two methods of testing, it is important that all the stoved specimens of the same sample should be exposed for an absolutely equal length of time to the atmospheric influences of the air.

Representation of Results

The results of the tests were graphed, the percentage moisture content of the samples being plotted on the X axis and the corresponding value of the strength on the Y axis. Curves were drawn through the plotted points in accordance with the principles of the method of equalisation to represent the strength as a function of the moisture content.

To provide a clearer picture, the results of all the samples are not reproduced here sepa-

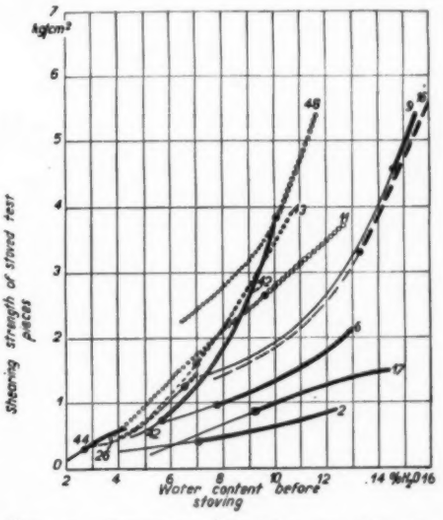

FIG. 4.—SHEARING STRENGTH OF STOVED SPECIMENS.

* Paper presented to the Polish International Foundry Congress.

rately but only the curves obtained therefrom. They are assembled in Figs. 2 and 3, and Figs. 4 and 5. Fig. 2 represents the cohesion determined on the basis of the compression strength in the green state. Fig. 3 represents the cohesion determined on the basis of the shearing strength in the green state. Fig. 4 indicates the shearing strength of the stoved specimens and Fig. 5 shows the compression strength of the stoved specimens.

The optimum moisture content, *i.e.*, the moisture content with which the sand may be rammed most easily, is marked on these curves

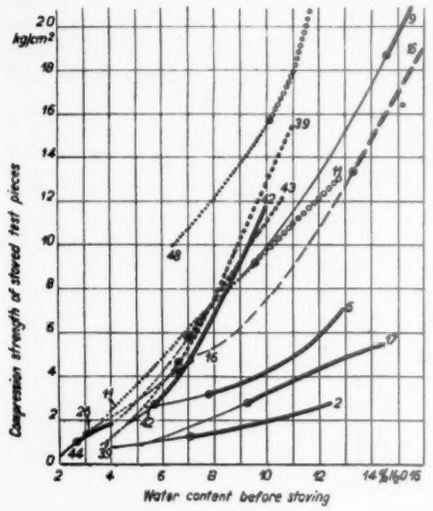

FIG. 5.—COMPRESSION STRENGTH OF STOVED SPECIMENS.

by a heavy point. On the curves indicating the cohesion, the moisture content range at which the sand is most satisfactory for ramming is indicated by a section drawn in a heavier line. Likewise, on the curves indicating the strength of the stoved specimens, the moisture-content range favourable for ramming the sand to be stoved is indicated by a section drawn in a heavier line.

Deduction of the Relationship

It may be gathered at first sight from Figs. 2 to 5 that:—

(1) The shearing strength is much lower than the compression strength.

(2) The reciprocal comparison of the cohesion of the various sorts of sand is practically the same, whether cohesion is determined on the basis of the compression strength or of the shearing strength.

(3) The order of the curves is the same in Fig. 2 as in Fig. 3.

(4) The compression or shearing strength of the green specimens depends in the same way upon the moisture content, that is to say, both the compression strength and shearing strength diminish with increasing moisture content of the sand. The curves in Figs. 2 and 3 resemble each other in shape.

(5) The compression strength and the shearing strength of the stoved specimens increase with increasing moisture content of the specimens when rammed.

Relationship Between Compression Strength and Shearing Strength of Green-Sand Specimens

This relationship is deduced numerically by means of Fig. 6, in which the moisture content of the sand has been plotted on the X axis in the same way as in Figs. 2 to 5, and the relationship:—

$$\frac{\text{shearing strength (in the green state)}}{\text{compression strength (in the green state)}}$$

has been plotted on the Y axis. The optimum moisture content of the sand concerned has been indicated on the curves by a heavy point (as in Figs. 2 and 3).

Table II (column 2) indicates the values of the relationship:—

$$\frac{\text{shearing strength (in the green state)}}{\text{compression strength (in the green state)}}$$

together with the optimum moisture content. The values of the relationship vary in the narrow limits of 0.345 to 0.387, the mean value being 0.36. The value of the shearing strength may be calculated on the basis of the compression strength as determined by test according to the equation:—

Shearing strength (in the green state) in kg. per sq. cm. = 0.36 × compression strength (in the green state) in kg. per sq. cm. .....Equation 1.

The shearing strength calculated according to equation 1 differs somewhat from that determined directly by test. Table II shows the differences in columns 4 and 5. The maximum divergence is + 6.5 per cent. and the probable divergence is ± 2.8 per cent. This is a comparatively small divergence and is without importance for the practical application of equation 1. Even the results of direct tests made in practice are liable to an error greater than ± 2.8 per cent., owing to the number of repeat tests being smaller and to the conditions being less favourable. As far as the author is aware, the law expressed by equation 1 is the most reliable of those which are applicable to the various qualities of moulding sand. With an increasing moisture content, the shearing strength diminishes less than the compression strength. The relationship:—

$$\frac{\text{shearing strength (in the green state)}}{\text{compression strength (in the green state)}}$$

increased with the moisture content in the case of 12 of 13 sorts of sand examined. According to Fig. 6, it is possible to calculate that the increase (or decrease) in the moisture content by 1 per cent. above (or below) an optimum moisture content increases (or diminishes) the value of this relationship by 0.014.

TABLE II.—*Relationship between Shearing and Compression Strengths (Green State).*

Designation of sand.	Value of the relationship: shearing strength (in the green state) / compression strength (in the green state) for the optimum moisture content		Divergences.		Square of the divergence.
	of the individual sands.	Mean.	Plus.	Minus.	
1	2	3	4	5	7
2	0.385	0.362	0.023	—	0.000529
6	0.364	0.362	0.002	—	0.000004
9	0.385	0.362	0.023	—	0.000529
11	0.358	0.362	—	0.004	0.000016
16	0.350	0.362	—	0.012	0.000144
17	0.387	0.362	0.025	—	0.000625
19	0.353	0.362	—	0.009	0.000081
24	0.345	0.362	—	0.017	0.000289
26	0.348	0.362	—	0.012	0.000144
39	0.371	0.362	0.009	—	0.000081
42	0.355	0.362	—	0.007	0.000049
43	0.353	0.362	—	0.009	0.000081
48	0.353	0.362	—	0.009	0.000081
Total ..	4.707	4.706	0.082	0.081	0.002653

Mean: $\frac{4.707}{13} = 0.362$

Probable divergence: $\gamma = \pm \frac{2}{3}\sqrt{\frac{0.002653}{13-1}} = \pm 0.010$

Probable percentage divergence: $\pm \frac{0.010}{0.362} \cdot 100 = \pm 2.8$ per cent.

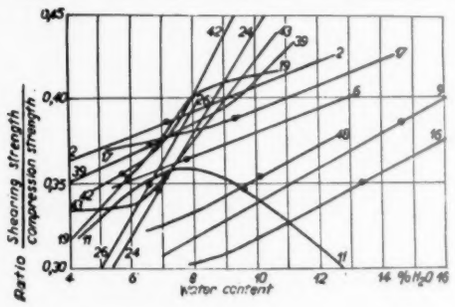

FIG. 6.

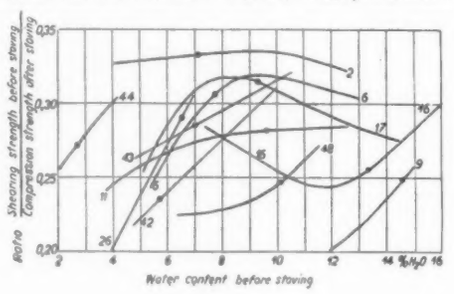

FIG. 7.

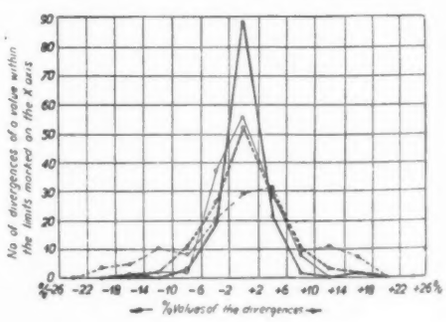

FIG. 8.

Relationship Between Compression Strength and Shearing Strength of Stoved Specimens

In Fig. 7 the moisture content of the sand has been plotted on the X axis, and the value of the relationship:—

$$\frac{\text{shearing strength of the stoved specimens}}{\text{compression strength of the stoved specimens}}$$

has been plotted on the Y axis.

The value of the relationship:—

$$\frac{\text{shearing strength of the stoved specimens}}{\text{compression strength of the stoved specimens}}$$

having an optimum moisture content varies between 0.235 and 0.332, its mean value being 0.28 (see Table III, column 3). The value of the shearing strength of the stoved specimens may be calculated by means of the following equation on the basis of their compression strength as determined by the test:—

Shearing strength of the stoved specimens in kg./sq. cm. = 0.28 × compression strength of the stoved specimens in kg./sq. cm. ... Equation 2.

The shearing strength calculated according to equation 2 differs somewhat from the value determined directly by test. Table III shows the differences in columns 4 and 5. The maximum divergence is + 16 per cent. and the mean divergence is ± 7.6 per cent. This divergence is comparatively slight and is of no importance for the practical application of equation 2. The divergences of equation 2 are greater than those of equation 1. This is probably due to the greater deviation of the results of the tests made with stoved specimens (see addendum).

TABLE III.—*Relationship between the Shearing and Compression Strengths (Stoved Specimens).*

Designation of sand.	Value of the relationship: shearing strength of stoved test specimens / compression strength of stoved test specimens for the optimum moisture content		Divergences.		Square of the divergence
	of the individual sands.	mean.	Plus.	Minus.	
2	0.332	0.278	0.054	—	0.002916
6	0.306	0.278	0.028	—	0.000784
9	0.249	0.278	—	0.029	0.000841
11	0.277	0.278	—	0.001	0.000001
16	0.255	0.278	—	0.024	0.000576
17	0.315	0.278	0.036	—	0.001296
26	0.290	0.278	0.011	—	0.000121
42	0.235	0.278	—	0.044	0.001936
43	0.285	0.278	0.007	—	0.000049
44	0.272	0.278	—	0.007	0.000036
48	0.246	0.278	—	0.032	0.001024
Total ..	3.062	3.062	0.136	0.136	0.009580

Mean: $\frac{3.062}{11} = 0.278$

Probable divergence: $\gamma = \pm \frac{2}{3}\sqrt{\frac{0.009580}{11-1}} = \pm 0.021$

Probable percentage divergence: $\pm \frac{0.021}{0.278} \cdot 100 = \pm 7{\cdot}6$ per cent.

TABLE IV.—*Deviation in the Strength in Shear and Compression Strengths of Sample No. I.*

Designation of sand ..		2		
Designation of specimen		1		
Moisture content of specimens, per cent.		4.00		
Specimen No.		1	2	3
Shearing strength of green specimens in kg.	Individual specimens	2.3	1.9	2.0
	mean	2.067	2.067	2.067
Divergence	Individual specimens in kg.	+ 0.233	−0.167	−0.067
	Per cent.	+11.3	− 8.1	−3.2
Square of divergence ..		127.7	65.5	10.2

With Moisture Content other than the Optimum Value

Within the moisture content limits advantageous for the test-specimen which is to be stoved, the value of the above-mentioned relationship (with only one exception) increases by about 0.01 with an increase of moisture content of 1 per cent.

Addendum

Although the shearing and compression tests were made by the same persons equally skilled in carrying out the two kinds of test, the deviation between the results of the shearing tests is much greater than that of the compression tests. To prove this fact, the divergences of the strength of each specimen from the mean value of the strength of all three specimens of the same sample were calculated on the basis of the tests made with sands Nos. 2, 6, 11, 16, 19, 43 and 48 (see example in Table IV). Fig. 8 shows the frequency curves of these divergences for each sort of test.

It will be seen that the values for each specimen diverge the least from the mean value of all the three specimens of the same sample in the compression strength test in the green state. In the majority of the tests (87 out of 135), the values diverge more or less by ±2 per cent. and the values diverge more or less by ±6 per cent. from the mean value only in eight tests. This means that for checking the work, it will merely be necessary to test a single specimen in the green state for compression strength.

The divergences were considerable in the test for shearing strength of specimens in the green state. The majority of the divergences are greater than ±2 per cent., and in 14 cases the divergence was greater than ±6 per cent. To obtain a result in the shearing test as reliable as in the compression test, it would be necessary to make at least twice as many shearing strength tests.

That is the great disadvantage of this method of determining the cohesion of moulding sand. The maximum divergences were observed in the shearing strength test of stoved specimens. Out of 135 specimens examined, 54 specimens showed a divergence greater than ±6 per cent., and 16 specimens had a divergence greater than ±14 per cent.

(*Continued from next column.*)

and the shape, colour, and distribution of the spark bundle is observed. Each grade of steel, depending upon its carbon content and the presence of alloying elements, produces a characteristic spark bundle, the recognition of which requires considerable experience. The test is purely qualitative and then only within wide limits.

Non-Destructive Testing

SOME OPTICAL METHODS

Optical methods of examining metals were described by DR. S. F. DOREY in the course of a Paper which he contributed to the Discussion on Non-Destructive Testing, held in London recently under the auspices of the Institution of Electrical Engineers. Extracts from the Paper are given below.

In the study of atmospheric corrosion and tarnishing of metals and alloys it has been found necessary to develop methods of optical examination of polished surfaces which will facilitate the assessment of the degree of polish. For this purpose apparatus has been devised for the quantitative determination of specular and diffuse reflectivity The specular reflection factor is measured as the ratio of the observed brightness of an illuminated white object after reflection at a prism, the reflection factor of which is known. The diffuse reflection is measured as the ratio of the brightness of the surface under test to that of a matt white surface under standard conditions of illumination and direction of view.

An optical method of checking the chemical analysis of metals is provided by the spectroscope. The test is not entirely non-destructive in character as it requires the striking of an arc between an electrode and the material under test. This causes a small burn or scar to be left on the specimen. The principle of the method is based on the fact that each element contained in the material emits characteristic rays of definite wavelength, the quantity of rays produced being directly dependent upon the amount of the element contained in the material. Analysis of the spectrum is carried out by means of a quartz prism in conjunction with a collimating lens which renders the rays of light parallel before they reach the prism, and readings may be made by direct visual observation of reflections on a suitably arranged graphical screen, or by means of a microphotometer with which precise determinations, which are independent of the human element, can be made. The former method relies on the visual observation of the person making the test in order to judge the intensity of the rays and so determine the quantity of the elements contained in the specimen. It is understood that spectrographic analysis is capable of determining the presence of elements in quantity greater than 0.0001 per cent.

An interesting and simplified adaptation of the spectroscope is to be found in an instrument called a "Spekker Steeloscope" which has been developed for works use as a means of rapidly checking large numbers of alloy-steel samples, thus reducing the amount of quantitative analyses to be carried out by chemical methods. As in the spectroscope, a direct-current arc is struck between the steel to be examined and another electrode, which may be commercially-pure iron or mild steel free from the elements it is desired to detect. The light from the arc, passing through a fine vertical slit, is directed upon prisms, which split the rays into their constituent wavelengths and project them towards a movable screen and eyepiece. The lines which appear are coloured according to their position in the spectrum, and each represents the image of the slit produced by its own particular wavelength. The manufacturers of the "Steeloscope" have provided charts which enable an operator after some experience to detect quickly the presence of various important alloying elements. The elements which are most readily detected are nickel, chromium, molybdenum, manganese, titanium, tungsten, cobalt, copper and vanadium.

A simple shop method of checking the quality of steel is by means of the "spark test." The metal is held in contact with a grinding wheel,

(*Continued in previous column.*)

Cardinal Points in the Modern Production of Light Ferrous Castings*

By J. A. REYNOLDS

It has often been said that the cupola is the heart of the foundry. Whilst agreeing with this axiom, it must be pointed out that other phases of foundry work are of equal importance if castings are to be successfully made. For instance, the best melting practice, conducted in the best-designed cupola, in the best-equipped foundry in the world, would not provide good castings if the composition of the pig-iron or scrap were unsuitable. Equally vital are such items as correctly-designed sand plant; selection and control of the grade of sand; the most suitable type of runners and risers, and the correct placing thereof. From the economic viewpoint, too, the latest methods of high-speed production must be applied to maintain one's place in the world markets. Moulding machines, shot-slingers, cranes, telphers and conveyors must eliminate manual work wherever they can be applied. One must remember, also, that machinery performs a humane *rôle* in freeing the worker from back-breaking toil. This is easily appreciated when one realises the fact that for every ton of castings produced, a minimum of a hundred tons of material is actually moved.

Cupola Practice

The design and operation of the cupola has passed through many phases. For light castings, the consensus of experience favours a soft-blast cupola, working at an air pressure of 6 to 10 ozs. per sq. in., with a single row of tuyeres of which the total area is approximately 20 per cent. (minimum) of the internal area of the furnace (measured at melting zone).

Bed Coke

The air provided should be 160 cub. ft. per lb. of good-quality hard coke, analysing 90 per cent. carbon (min.), sulphur 0.8 per cent. (max.), and ash 8 per cent. (max.). Bed coke should extend (when first charged) to 3 ft. above the tuyeres. Text-books are often misleading on this point, stating that the bed coke should be 1½ to 2 ft. above the tuyeres; what they should say is that the *melting zone* extends 1½ to 2 ft. above the tuyeres. Actually the height of the melting zone is dictated by the volume and pressure of air as it reaches the inside of the cupola opposed by the resistance of the column of materials. This point can easily be verified by examining the contour of the walls immediately after the furnacemen have cleaned off the adherent slag, etc., prior to re-patching the melting zone.

After ascertaining that the bed coke is lit up evenly, the cupola should be charged and left to stand for ½ to 1 hour. The extra depth of coke on the bed heats up the first charge or two and allows for the heat losses due to the cold walls, etc. Unless this extra coke is used, the first charge or two may have to be poured away into pigs.

Weight of Charges

The weight of iron per charge should approximate 1½ lbs. per sq. in. of the cupola area, and the coke necessary to melt this should be 10 to 12 per cent. of the iron by weight. This coke usually occupies a depth of 6 to 8 in. in the cupola stack. For a cupola of 26 in. internal dia. the charge should not exceed 7 cwts. and the coke layer 80 to 100 lbs. Metal melted under the above conditions fluxed with limestone, and/or fluorspar should come down white-hot and lively enough to run castings $\frac{3}{32}$ in. thick.

Conditions can be assumed to be correct when metal appears past the tuyeres in 5 to 8 minutes from commencement of the blow, and is maintained at a speed of 10 to 12 lbs. per hour per sq. in. of the cupola area. For a 26-in. dia. cupola this means 2.4 to 2.8 tons per hour. One hears wonderful records of melts with coke/iron ratios of 1 to 15 and so on, but for light castings any attempt to achieve this usually ends in spoiled castings, due to misruns and badly oxidised metal ("Spare the coke and spoil the charge," to paraphrase an old maxim).

High blast pressures, even with correct splits of coke, cause the metal to come down white-hot, but with no "life." Incidentally, with small cupolas, high blast pressure leads to "bridging" of the cupola. When blowing down, the fan speed should be retarded, otherwise excess air is blown in, resulting in oxidised iron and erosion of the cupola lining.

Other causes of failure to produce good metal for light castings are: (1) soft coke, which also leads to bridging; (2) high-sulphur coke, particularly if the sulphur occurs as iron pyrites (Fe_2S) as in the case of some local cokes; (3) unbalanced or wrong composition of iron. In this connection one should be careful to avoid pig-irons with high sulphur and low manganese contents (0.08 S and 0.3 Mn). The low manganese is insufficient to neutralise the sulphur and provide a safety margin, and results in cracks, hard castings and sometimes "inverse chill."

Composition

For stoves, rain-water goods, electrical boxes and similar light castings, an ideal composition would be: Si, 2.6 to 3.2; S, 0.07 max.; T.C, 3.0 to 3.5; Mn, 0.6 to 0.8, and P, 0.8 to 1.2 per cent. The lower the sulphur, the lower can the silicon and manganese go with safety. "Kishy" iron can be guarded against by careful selection of pig-irons. The author's method is to include a proportion of high-silicon pig-iron, because this initially has low carbon, and if the silicon in the mixture is kept on the high side (about 3.0 per cent.) the molten metal does not throw out "kish" and is cleaner and livelier.

As would be expected from the lower carbon content, the iron is also strong, the average transverse test on M bars ($\frac{7}{8}$ in. dia. at 12 in. centres) being 11 cwts., with a deflection of 0.125 and a tensile strength of 11.5 tons per sq. in. (B.S.S. "C" grade calls for transverse 960 lbs. and tensile 10 tons). The Brinell hardness will be of the order of 180 to 212. Excess of silicon in the final mixture should be avoided, as this causes hardness and brittleness in thin castings.

Methods of Running

The successful running of light castings entails as much foresight and thought as for heavy castings. In castings having much surface area sprays must be carried well round one side and sometimes two sides, being poured "two up." Vitally important is the correct positioning of the spray ingates so as not to cause cracking of the casting, washing away of small isolated projections of sand or mould erosion near the gate entry, or sullage at heavy bosses. In moulds of large surface area it is bad practice to use one ingate. Spray ingates are essential. In some instances spinning is necessary to prevent metal striking with undue force against cores or inner walls. Where machined faces must be cast "up," filter cores are used in the downgates to give clean iron.

Thin flat plates often show cold laps and uneven thickness due to the metal swishing about in streams and setting before the mould is full. One cure for this is to fill the mould quickly; another is to tilt the mould.

The problem of moulding sand may be summarised under two heads: (1) selection of basic sand, or sands, of appropriate chemical composition and physical structure, and (2) efficient preparation and maintenance of the sand.

Selection of Sand

Consider a typical Bunter sand:—Silica (SiO_2), 85 to 86; iron oxide (Fe_2O_3), 2 to 3; alumina (Al_2O_3), 5 to 6; lime (CaO), 0.5; alkalis (Na_2O and K_2O), 1.5, and moisture, 2 per cent. The mechanical analysis shows:—Coarse sand (over 0.5 mm.) = 2 per cent.; medium sand (0.25 to 0.5 mm.) = 10; fine sand (0.10 to 0.25 mm.) = 70; silt and clay grade (0.01 to 0.10 mm.) = 18 per cent.

For light castings, refractoriness of the sand is not of paramount importance, so that the silica content mentioned is sufficiently high. The alumina gives bond or plasticity to the sand when moistened. The iron oxide also gives bond and is an important constituent, since sand containing it possesses longer life than those containing clay alone.

Alumina or clay, when burnt out by molten metal, loses its power of rehydration (that is, its power to re-absorb water and so become plastic again), whereas sand containing ferric oxide possesses this power in greater degree. Ferric oxide under the action of heat also causes a roughening of the grain, which also creates bond. The alkalis form easily-fusible silicates, and any excess over 2 per cent. is detrimental to good finish.

An ideal sand would contain one dominant grain size (which for light castings should be 0.1 to 0.25 mm.). If the sand be composed of mixed sizes, the porosity is lowered seriously, due to the small grains packing between the large grains. The same remark applies to silt.

Sand for light castings should possess (*a*) cohesiveness or bond strength; (*b*) permeability; (*c*) refractoriness to a certain degree; and (*d*) flowability if sand is to be rammed by power moulding machine.

Cohesiveness

This property is controlled by: (1) *The amount of clay and ferric oxide.*—This can be judged roughly by noticing if the sand cakes badly when milling. (2) *The moisture content.*—Some sands need less moisture than others to attain maximum strength, a naturally-bonded sand for jobbing work needing 5½ to 6½ per cent., whereas for machine moulding 4½ to 5½ per cent. is best, and for synthetic sand for machine moulding 3 to 4 per cent. is ample. (3) *The efficiency of the milling and mixing.*—Possibly the much-used term "milling" is a misnomer, the ideal sought being to rub a coat of clay round each grain of sand, which, when moistened, gives plasticity to the mass. Insufficient milling results in patchy cakes of sand, whereas prolonged milling (particularly if too heavy millers are used) crushes the grains. (4) *The density at which ramming is carried out.*—The bond strength increases with ramming pressure. Hand ramming varies between 20 to 30 lbs. per sq. in., and on power squeezer machines between 30 to 60 lbs. per sq. in. Excess pressure causes blows and scabs, and insufficient pressure causes "flop outs" and swells. The ideal bond strength for light work is 6 to 8 lbs. per sq. in.

Permeability

This is affected by the factors 1, 2, 3 and 4, given above. Whatever makes for maximum cohesiveness tends to lower permeability. Two other factors affecting permeability are: (*a*) Amount and grain size of coal-dust, and (*b*) presence of silt in the facing or backing sand. If the coal-dust is too large in grain size, it causes "pitting," and if too much of it is used "rat tails," "mapping" and misruns can occur. Any silt in

* Paper read before the Lancashire Branch of the Institute of British Foundrymen.

CLEAN IRON
SAVES COKE IN THE CUPOLA

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- **Castings cleaner.**
- **Metal composition more regular.**
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the facing or backing sand should be removed by a desilting machine. The permeability should average 70 for facing sand, and 75 (A.F.A.) for backing sand. For high-speed machine moulding it is essential to eliminate needle-venting. Sand must therefore be self-venting and to this end must be worked as dry as is possible without risking "drop-outs."

Refractoriness

For light sections trouble is not likely to be caused through refractoriness, providing the alkali content is kept below the limits already stated.

Flowability

This property is relatively unimportant for hand-rammed moulds; but where jolting or power squeezing is carried out at high speed it is essential, in order to ensure a rapid flow of sand into corners and deep pockets of the mould, that the sand should contain minimum moisture and be consistent in grain size, rounded grains giving the best flow. Hot steaming sand should also be obviated, particularly in continuous casting plants.

Coal-Dust and Mould Facings

Coal-dust, in addition to its function of producing hydrocarbons—a gas which prevents "burning-on" of sand—also gives a tarry bond to the sand on re-use. Good-quality coal-dust, besides being consistent in grain size, should have a volatile content of 30 per cent. (min.) and maximum ash content of 10 per cent. About 5 per cent. coal-dust is the usual amount added to facing sand. In order to save the machine moulders' time in shaking and sleeking dry blacking on the mould, some founders add 1 or 2 per cent. of blacking to the facing sand, reducing the coal-dust by this amount. The grain size of coal-dust should range between 150 B.S.I. and 200 B.S.I. sieve.

Core Sand

The use of oil-bonded sea-sand is now so universal for light castings that it is scarcely necessary to deal with natural clay-bonded sand cores. Sea-sand, being almost free from clay and organic matter, and being composed usually of rounded grains, makes an ideal core from the point of view of permeability. Incidentally, much work in the dressing shop can be saved by oil-bonded sands, the cores falling out after a mere tap.

Preparation and Maintenance of Sand

There are on the market many instruments for testing sands. Some of them are perhaps more suitable for laboratory than foundry use, but in skilled hands they provide valuable standards to work to in the foundry. A good tool for use in the foundry is a meter for testing the relative hardness of a rammed mould, while the "Speedy" apparatus for moisture determination is another. The author has found a small hand microscope with magnifications from 40 to 60 to be a valuable tool. Apart from its use in detection of flaws and cracks in metal, it reveals more about the nature of sand with regard to size, shape and consistency than sieves could possibly do. A wash bottle to wash the clay off the sand grains prior to examination under the microscope also gives an idea of the amount of clay in the sand. The benefits of sand control can be summarised as better finish, fewer wasters, quicker production, less new sand, less old sand to transport and tip, and the use of cheaper local sands.

Sand Plant

Sand plant may be divided into: (1) batch mixers for non-continuous-casting foundries, and (2) continuous sand plants for mechanised foundries. In the first type, facing sand is prepared as follows:—"Knock-out" sand is passed through a power sieve or screen to break up the lumps, silt being extracted usually by a suction fan. It is important for the success of this operation that the sand be not damp. The sand is then passed over a magnetic pulley or belt to remove iron pellets, sprigs, etc. From a storage hopper, this cleaned sand is fed into the mill by bucket loader, the new sand and coal-dust being added into the bucket. Water is usually added by a pipe, with outlets spaced round the mill, the amount being usually controlled by a flush cistern. After milling, the facing sand is ploughed automatically into a disintegrator and thence dropped into barrows or bogies.

The addition of the cleaning process (scarcely known until about five years ago) shows great economy in the amount of new sand necessary, and consequent saving in carting away of excess old sand. The elimination of iron pellets and fines also improves the castings and decreases the number of wasters.

For backing (or floor) sand, the best procedure is to damp the knock-out sand and then pass it through a power sieve or thrower, which combs out the unwanted vents, sprigs, etc., and cools and fluffs up the sand into good condition for re-use. Periodically it is advisable to add silica sand to open up the grain, or red sand to restore the bond.

In the case of continuous plants, as a rule all the sand is passed through the desilting, magnetting, mixing and disintegrating machines, only one type of sand being used, *i.e.*, no separate facing and backing sand. The chief difference in the two methods is that, whereas about 15 to 25 per cent. new sand is usually added in the facing sand for jobbing plants, the amount of new sand added to the bulk sand in continuous plants represents about 5 per cent. only. Another difference is that, whereas in the case of facing sand 5 min. is necessary to effect proper milling (actually the bond improves up to about 10 min. milling), in the case of bulk sand for continuous casting the sand is only milled for 1½ to 2 min.

Other Factors

It would be impossible to conclude a Paper on modern production without including references to the advantages of adequate ventilation (positive as well as natural), good lighting as provided by the new mercury and sodium vapour lamps, cleaning units like the shot-blast and impeller-type machines, continuous sand plants and mould conveyors and the latest type moulding machines.

Indeed, the most revolutionary developments in foundry machines in recent years, practically reducing the labour to the mere pulling of a lever or pressing a button, are:—

(1) Cleaning machines in which the shot is slung on to the casting by a high-speed impeller, dispensing with compressors and air receivers, with consequent saving in running costs. A cleaner finish in less time is also claimed.

(2) A pneumatic jolt-squeezer machine on which the head is swung in, the mould jolted, squeezed, vibrated and stripped in sequence automatically by one lever.

(3) An electro-magnetic squeezer, which squeezes, vibrates, cuts down-gits, and strips, by pressing two buttons. In this machine no pumps, accumulators, pipe lines, or air receivers are needed, and therefore running and maintenance costs are negligible. The actual squeeze and strip operation takes only 6 secs.

The author desires to tender his thanks to British Insulated Cables, Limited, for their kind permission to read this Paper.

Vee Rope Drives

Ira Stephens, Limited, Whitelands Leather Works, Ashton-under-Lyne, have issued a new table compiled for the purpose of ascertaining and determining the details of Vee rope drives, many of which have been installed during the last few years. The basis of this table is that the total pulley diameters are adopted, giving a variety of shaft centres. The usual elaborated tables give only one shaft distance for each speed ratio, whilst the new table gives a choice of many. The firm has also issued a horse-power computer for Vee rope drives (price 1s.).

Bolts in Pattern Construction

By H. R. THOMAS.

To assemble the various pieces of a pattern, nails and screws are most often used; yet there are cases when the use of bolts and nuts is advantageous. Fig. 1 illustrates a section of a half-pattern for a circular casting such as a flanged pipe, and shows two methods of securing the flange and core seat. The right-hand half outlines the usual construction with the use of screws, while the left-hand view depicts the flange being kept in position with bolts and nuts. Besides facilitating assembly originally, the use of bolts offers an advantage in the foundry. For example, when a number of brackets is required to strengthen the flange, as in the sketch, it is advisable to reinforce the edges of the mould by nailing. This is best done when the pattern is in position to avoid disturbing the mould. In the case of the right-hand method, when the pattern is withdrawn only the brackets remain in the mould, but with the alternative construction the flange is also retained in the mould. Bolted to

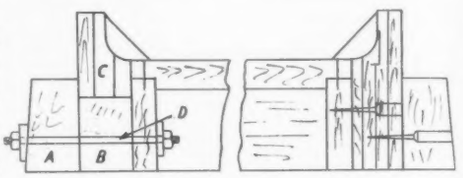


FIG. 1.

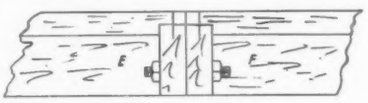


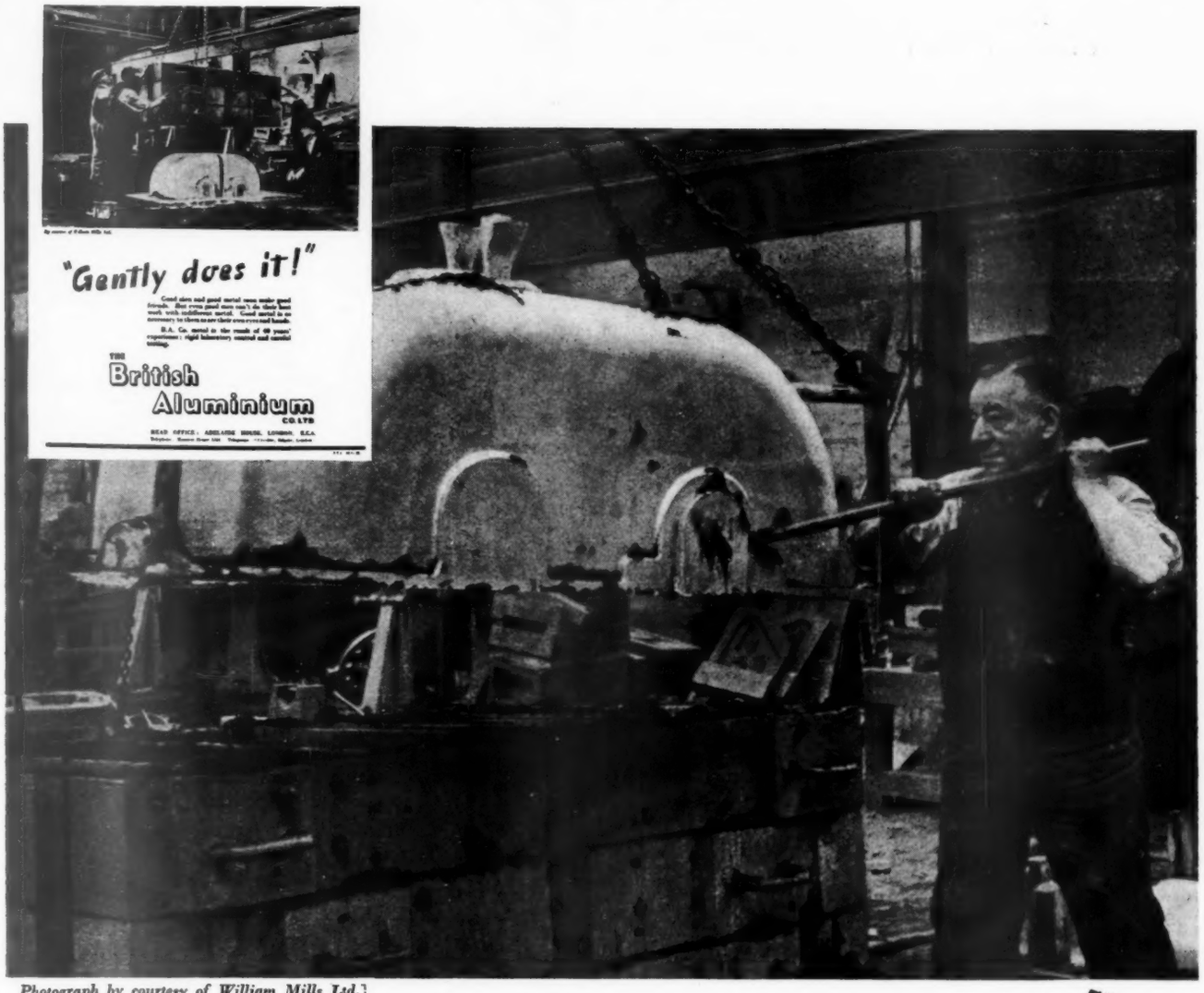
FIG. 2

the main body is the core seat A and "fuller" B. The flange C, situated between them, is kept in position by tightening the bolts D. Prior to withdrawal, the bolts are loosened, and the main body, together with A and B, is then removed, leaving flange C in the mould with the brackets. The sand is then reinforced and the flange and brackets subsequently removed. The flange being placed over the "fuller" B, the bolts are tightened and the pattern made ready for the next ramming.

Fig. 2 illustrates another use of bolts in pattern construction, this example being the linking of two separate pieces of pipe pattern E and F to form a longer piece than could be conveniently made in one length. In addition, bolts are very useful for keeping frame core-boxes together, and wing-nuts should be used in these cases for easy loosening.

United States Blast Furnaces

The United States steel industry to-day has 60 per cent. fewer blast furnaces than 50 years ago, but technical progress in blast-furnace construction and operation has increased the total blast-furnace capacity of the country by about 300 per cent. during the half-century period. Over the same period, the number of employees in the industry has nearly tripled despite the sharp reduction in the number of blast furnaces, according to the American Iron and Steel Institute. In 1889, a total of 575 blast furnaces was available for the production of pig-iron and ferro-alloys in the United States. Total capacity of the furnaces was 13,168,000 tons of pig-iron and ferro-alloys per year. Although by 1938 the number of furnaces had decreased to 236, their total capacity was about 51,221,000 tons a year. About 87 per cent. of the blast furnaces standing in 1938 are located in six states, Alabama (20), Illinois (23), Indiana (19), New York (17), Ohio (48), and Pennsylvania (78).



Photograph by courtesy of William Mills Ltd.

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F.T.J. 8-12

The Week's News in Brief

Trade Talk

THE 39TH CONVENTION of the International Acetylene Association is to be held at Houston, Texas, on March 8, 9 and 10 next.

SHAW GLASGOW, LIMITED, Maryhill Ironworks, Glasgow, are to undertake the manufacture of cast-iron pipe by the centrifugal process.

THE SCOTTISH MACHINE TOOL CORPORATION, LIMITED, Glasgow, has just shipped to the U.S.S.R. about 400 tons of heavy machine tools.

AN INSTITUTION of British Agricultural Engineers has been formed. Mr. C. Horton, Hobart House, Wilton Street, London, S.W.1, is the secretary.

NO. 1 BLAST FURNACE at the Renishaw Ironworks, near Sheffield, is to be damped down. It is hoped that operations will be resumed in the near future.

BRISBANE CITY COUNCIL, Queensland, is placing another order with Albion Motors, Limited, Glasgow, for Diesel-engined buses. The contract is valued at £20,000.

THE ADDRESS of the International Tin Research and Development Council will be changed, on and from December 25, to Fraser Road, Greenford, Middlesex. The telephone number will be Perivale 4254.

THE ENGINEERING employers have asked the Amalgamated Engineering Union and the National Union of Foundry Workers to reconsider the claims recently put forward for conditions of payment for piecework, overtime and night-shifts.

HARLAND ENGINEERING COMPANY, LIMITED, Alloa, are to supply two electrically-driven centrifugal-pump units of 25,000 galls. per hr. capacity, with all attendant pipework, switchgear, etc., at Dearne Valley Colliery for Dearne Valley Water Board.

A NEW RECEPTION HALL and grounds for the employees of Wm. Park & Company, and of English Tools, Limited, at Clarington Forge, Wigan, were formally opened last week by Mr. Sydney Park, J.P. The recreation hall contains a well-equipped works canteen.

A NEW RANGE of heavy-duty shaping machines has been developed by Churchill-Redman, Limited, Halifax. The power rapid traverse is a distinctive feature, and is operated by a lever close to the operator's hand, and functions in the direction opposite to the feed set.

THOS. W. WARD, LIMITED, Sheffield, have purchased from John Fowler & Company (Leeds), Limited, the goodwill, patterns, drawings, and sole manufacturing and distributing rights of their range of concrete mixers, winches, hoists and elevators, to take effect from December 15.

B.E.N. PATENTS, LIMITED, are moving their offices and works, early in the new year, from Park Royal to High Wycombe, where they have built a new and larger works adjacent to their associate company, Broom & Wade, Limited. Their new address from January 3 will be :—Hughenden Avenue, High Wycombe, Bucks.

MR. STANLEY CLOWES, of Sheffield, has been appointed general manager of a new company which is to be formed in the machine-tool industry and which will operate at Manchester. Mr. Clowes leaves Samuel Fox & Company, Limited, Stocksbridge, where he has been development engineer and wire-mill manager. The new undertaking is stated to have considerable financial backing and will employ 300 to 400 men.

ONE OF THE ACTIVITIES of the Meehanite Research Institute is the annual conference of foremen and metallurgists of the companies engaged in the manufacture of Meehanite. This year's conference was held on November 25 and 26 at the works of John Harper (Meehanite), Limited, by courtesy of the directors and management. A feature of the conference was the frank interchange of operational and practical details, and the real co-operation between the metallurgists and foremen of all the companies concerned. The first day of the meeting opened with a technical session, at which research Papers were presented. The delegates were entertained to luncheon at the Lion Hotel, Willenhall, following which the complete works were open for inspection. In the evening a dinner was given by the management of John Harper (Meehanite), Limited. On the second day another technical session was held, when further Papers were presented by representatives of the various licensees.

Personal

SIR ROBERT HADFIELD, chairman of Hadfields, Limited, Sheffield, celebrated his 80th birthday on Monday, November 28.

MR. FRANK PRICE has been appointed home-sales supervisor of Blackstone & Company, Limited, Stamford, a position which his father, the late Mr. Tom Price, held before joining the board of the company.

MR. ROBERT CLARK, J.P., who began his apprenticeship as a moulder with the Carron Company and later with M. Cockburn & Company, Limited, Falkirk, eventually serving 57½ years with the Falkirk Iron Company, where he was foreman of the moulding department for 30 years until his retirement in March last, celebrated his golden wedding on November 30.

Obituary

MR. CHARLES HENRY SMITH, foreman for many years of the annealing shop of Ley's Malleable Castings Company, Limited, has died as the result of a motor accident. He was 68.

THE DEATH took place on December 2 of Mr. J. E. Cowen, who was managing director and chairman of Smith, Patterson & Company, Limited, iron-founders, Blaydon-on-Tyne, and a director of the Consett Iron Company, Limited, and other companies. Mr. Cowen was 65 years old. In 1927 he was High Sheriff of Northumberland.

AS WE CLOSE for Press, we learn with regret of the death of Mr. E. Ronceray, which took place last Monday in a Paris nursing home. Mr. Ronceray was an honorary member of the Institute of British Foundrymen, a Past-President of the French Foundrymen's Association and founder of the Paris Foundry High School. A full biographical note will be published next week.

MR. PETER DEAS, a leading foundryman in the North of England, died suddenly at his home at Redcar last week. A native of Glasgow, Mr. Deas went to Tees-side in 1889 to assist in the establishment of Thomas Allan & Sons, Limited, Bonlea Foundry, Thornaby-on-Tees. He rose to the position of managing director of the enterprise in 1911 and when he relinquished that position five years ago was elected chairman of the company. He was one of the original members of the National Light Casting Founders' Federation and served on the Executive.

Contracts Open

Atherton, December 13.—Cast-iron spigot and socket pipes and special pipes for 12 months, for the Urban District Council. Mr. W. T. Duxbury, gas manager, Town Hall, Atherton.

Liskeard, December 28.—Providing and laying of steel and spun-iron pipes, for the Borough Council. Sandford, Fawcett & Partners, consulting engineers, 53, Victoria Street, London, S.W.1. (Fee £5 5s., returnable.)

London, N., January 11.—E.h.t. and l.t. paper and rubber cables, cast-iron pipes, iron castings, transformers, etc., for twelve months commencing April 1, 1939, for Islington Borough Council. Mr. W. Eric Adams, town clerk, Town Hall, Upper Street, N.1.

Shanklin, December 19.—Supply and erection of vertical 4-stroke cycle heavy oil engine, centrifugal pump, gears, for the Sandown-Shanklin Urban District Council. Cooper & Corbett, consulting engineers, Post Office Chambers, Shanklin. (Fee £5 returnable.)

Southport, December 13.—500 yds. of 15-in. dia. spigot and socket cast-iron or spun iron pipes, and specials, for the Southport and District Water Board. The Engineer, 14, Portland Street, Southport. (Fee £2 returnable.)

Wareham, December 21.—Supply and erection of two sets of vertical spindle centrifugal pumps and electric motors with automatic control, for the Borough Council. Lemon & Blizard, consulting engineers, Castle Lane, Southampton. (Fee £3 3s., returnable.)

Company Reports

Hick, Hargreaves & Company, Limited.—Interim dividend of 2 per cent.

W. & T. Avery, Limited.—Interim dividend on the ordinary shares of 5 per cent.

Bradley & Foster, Limited.—Interim dividend on the ordinary shares of 4 per cent.

Allied Ironfounders, Limited.—Interim dividend on the ordinary shares of 4 per cent.

Aveling-Barford, Limited.—Interim dividend on the ordinary shares of 5 per cent., free of tax.

Marshall Sons & Company (Successors), Limited.—Final dividend of 5 per cent., making 7½ per cent.

Broom & Wade, Limited.—Final dividend of 15 per cent., making 22½ per cent. for the year to September 30.

John Brown & Company, Limited.—Interim dividend of 6d. a share, or 5 per cent., free of tax, on the ordinary share capital.

J. Brockhouse & Company, Limited.—Final ordinary dividend of 7½ per cent., making 15 per cent. for the year to September 30, 1938.

Allied Ironfounders (Ireland), Limited.—Report to June 30 last states that a further £12,420 has been added to debit of profit and loss account.

David Brown & Sons (Huddersfield), Limited.—Profit for the year to September 30, after charging depreciation, £160,456; brought in, £167,201; income tax and N.D.C., £60,709; written off investments, £6,490; dividends on preference shares, £14,975; dividend on the ordinary shares of 10 per cent., £21,100; carried forward, £224,384.

Atlas Steel Foundry & Engineering Company, Limited.—Profit for the year to September 30, £45,815; brought in, £2,017; to depreciation, £5,000; to general reserve, £13,900; to investment reserve, £3,700; interim dividend of 10 per cent., £5,625; final dividend of 15 per cent. and a bonus of 10 per cent., £14,062; carried forward, £5,544.

Forthcoming Events

DECEMBER 12.

Sheffield Society of Engineers and Metallurgists :—"Open-Hearth Process." Paper by R. Percival Smith, at Department of Applied Science, St. George's Square, Sheffield, at 7.30 p.m.

DECEMBER 13.

Institute of Marine Engineers :—"'Loded' Cast Irons." Paper by H. J. Young, at the Institute, 85, Minories, London, E.C.3, at 6 p.m.

Institute of Metals (North-East Coast Section) :—"Aluminium Alloys in the Foundry." Paper by R. Givern, at Electrical Engineering Lecture Theatre, King's College, Newcastle-upon-Tyne, at 7.30 p.m.

Institute of Metals (Swansea Section) :—"Relationship between the Mechanical Properties of Metals and the Liability to Breakdown in Service." Paper by L. W. Schuster, at Y.M.C.A., Swansea, at 6.30 p.m.

Institution of Chemical Engineers :—"Principles of Design in Modern Industrial Furnaces." Paper by C. Webb, at Geological Society's Rooms, Burlington House, Piccadilly, London, W.1.

DECEMBER 14.

Institute of Welding (Tees-side Branch) :—"Non-Ferrous Welding." Paper by H. W. G. Hignett, at Cleveland Scientific and Technical Institute, Middlesbrough, at 7.30 p.m.

Institution of Locomotive Engineers :—"Wear Resistance of Ferrous Materials." Paper by W. West and C. C. Hodgson, at Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 6 p.m.

Institute of British Foundrymen

DECEMBER 12.

Lincolnshire Section :—"Time and Motion Studies in the Foundry." Paper by C. D. Pollard, at Lincoln Technical College, at 6.45 p.m.

DECEMBER 13.

Burnley Section :—Paper on non-ferrous subject, by A. Jackson, at Municipal College, Burnley, at 7.30 p.m.

DECEMBER 15.

East Anglian Section :—"New Factory Regulations as Applicable to Foundries." Paper by Miss D. McWilliam, at Central Library, Ipswich, at 7.30 p.m.

DECEMBER 16.

Lancashire Junior Section :—"Quantity Production of Castings from Small Loose Patterns." Paper by W. Frith and A. Boyes, at College of Technology, Manchester, at 7.30 p.m.

London Branch :—Annual dinner and dance, at Criterion Restaurant, Piccadilly Circus, W.1, at 7 p.m.

The Institute of Vitreous Enamellers

DECEMBER 15.

Scottish Section :—"Control of Enamel Slip in the Enamel Plant." Paper by R. Vidal, at Royal Technical College, Glasgow, at 7.30 p.m.

Southern Section :—"Application of Factories Act to Vitreous Enamel Shops." Paper by A. W. Garrett, at Charing Cross Hotel, London, at 8 p.m.

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Raw Material Markets

All sections of the iron and steel trades are awaiting the publication of prices for delivery after the turn of the year. In some cases consumers are still able to specify for deliveries under contracts, but where these have expired users are ordering on a day-to-day basis. Makers are anticipating some heavy business in the New Year, and, although stocks are likely to suffice for some little time, they are preparing to increase their outputs should the necessity arise. In all districts firms who are working on Government orders in connection with the rearmament programme are well employed and are likely to remain so for a considerable time.

Pig-Iron

MIDDLESBROUGH.—Consumers' stocks generally are very low, but users are not entering into further contracts until there is a firm price basis for forward business. A few prompt orders are being placed, but the aggregate tonnage has fallen to a very low level. Although buyers are anxious to know the producers' decision with regard to prices for next year's deliveries, makers for their part are also keen to make an early announcement, as they are desirous of learning whether their present level of production will be sufficient to meet the future demand or whether they will be compelled to expand their output. As soon as certain difficulties have been surmounted, the new prices will be made known. Hematite consumers continue to call for heavier deliveries, but they are mostly well covered and are not entering into new contracts, so that knowledge of future quotations is less important in this section than in the case of foundry iron. No doubt there will be a certain amount of buying in the early part of the New Year, but it is not expected that any real buying movement will develop until later. Makers have recently increased their productions in some cases, but stocks are still fairly heavy. One reason for the increase in the demand for contract deliveries is that any unexpired portions of current contracts which are held over until January will be charged at the new quotations.

LANCASHIRE.—Owing to the lack of information regarding prices of iron for delivery after December 31, many consumers in this area have been unable to deal with inquiries in the normal way. In fact, many firms have expressed their dissatisfaction with the system under which they are kept waiting until the last minute and state that they have been seriously inconvenienced, particularly with regard to export business. Textile machinists, especially, have found difficulty in quoting for orders from overseas. Meanwhile, there is little new business in the iron market and only small tonnages are involved in any transactions. Offers of Staffordshire and Derbyshire brands of No. 3 foundry iron are on the basis of 114s., with Northamptonshire No. 3 at 112s. 6d. and Derbyshire forge iron at from 111s. to 113s. per ton, according to the class of consumer. Hematite has not been in much demand and new business is negligible. West Coast iron is quoted at 141s. and East Coast hematite at 140s. 6d.

MIDLANDS.—Although some consuming works are still well covered for supplies of high-phosphorus iron, others have worked off stocks and are having to buy additional tonnages as they require them. No new forward contracts are being made until the price situation is clearer. In the case of the light-castings makers, particularly, stocks are heavy and these concerns are unlikely to take up further supplies for a considerable time, as this is their customary quiet season, although it should be said that they have had a very lean time for several months. Low-phosphorus iron, at from £5 10s. to £6 10s. per ton, is in quite good request. In view of the fact that prices of this iron are not controlled by an official body, consumers have not entered into long-term contracts, but are buying moderate tonnages as the need arises. Most hematite consumers have not enjoyed a very good year; they covered their requirements well ahead in the early part of 1938, but, owing to the lack of orders, consumption has not been up to expectations during the past few months and consequently many of them have still large tonnages under contract, which they will have to take up before entering into further contracts.

SCOTLAND.—Many consumers are still dubious as to the trend of prices and think that perhaps no reduction will be made for deliveries after the end of the current year. On the whole, however, users anticipate that quotations will rule at lower levels in the New Year. Meantime, new business is very quiet. The output of 11 blast furnaces in this area is more than sufficient to meet the demand, and stocks at producers' works are still accumulating, although delivery specifications have certainly increased of late. Light-castings makers are working only part of each week, but the outlook has somewhat improved as the result of the placing of a housing contract for Scotland, which is valued at £1,000,000. No improvement has occurred in the position at local steelworks; although they are fairly well employed, they are well covered for their pig-iron requirements.

Coke

Although producers of foundry coke have decided to maintain the price of coke at a minimum of 50s. 6d. up to the end of June next, there has been little or no increase in the trade. Many consumers are covered up to the end of December, while others have booked supplies deliveries of which are not due to cease before the end of the first quarter of 1939. Export orders continue to be received on a satisfactory scale.

Steel

To a great extent business in steel products is suspended pending the announcement of the new prices, which it is expected will be made shortly, says the official report of the London Iron and Steel Exchange. Trading has been principally confined to small prompt parcels sufficient to carry consumers over until the end of the year. Business in semi-finished steel has broadened, although in this department, in common with other sections of the steel trade, it is restricted to small supplementary tonnages. The gradual clearing of stocks, however, has led to a strengthening in the position, and it is anticipated that a considerable volume of new business will come on the market when the new prices are declared. The position in the finished steel section of the market is not altogether satisfactory, and many of the works are short of orders. There is a tendency, however, to increase outputs and optimism is expressed with regard to the conditions which are likely to rule in the New Year. Export business is quiet and oversea buyers are limiting their purchases to small quantities.

Scrap

Although the call for supplies of heavy steel scrap continues to be on a heavier basis, there is not much in the way of new business being offered, as most consumers are much behind schedule in their contracts. In any case, there is the possibility of lower prices ruling in the New Year. In other sections of the market, also, there is considerable uncertainty owing to the question of future quotations.

Metals

Copper.—This market has not been very active during the past week as far as new business is concerned, and only small tonnages have changed hands. The American domestic price has not yet been reduced, but the possibility of this has had a rather weakening effect in this country. Business in the United States, too, has been on the quiet side, and will remain so while the chance of lower quotations is about. On the Continent, the French labour troubles continue to cause a certain amount of disquiet, while the international situation that has arisen as a result of Italian claims on French territory has further upset the commercial world.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £43 10s. to £43 12s. 6d.; Friday, £43 1s. 3d. to £43 2s. 6d.; Monday, £42 1s. 3d. to £42 3s. 9d.; Tuesday, £42 5s. to £42 7s. 6d.; Wednesday, £43 7s. 6d. to £43 8s. 9d.

Three Months.—Thursday, £43 15s. to £43 16s. 3d.; Friday, £43 5s. to £43 6s. 3d.; Monday, £42 6s. 3d. to £42 7s. 6d.; Tuesday, £42 10s. to £42 12s. 6d.; Wednesday, £43 12s. 6d. to £43 13s. 9d.

Tin.—There was little change in the total visible supply of tin during the month of November. According to the statistics compiled by Mr. W. H. Gartsen (Henry Rogers, Sons & Company), the total visible supply on November 30 amounted to 29,432 tons, against 30,359 tons at the end of the previous month. These figures include the carry-over in the Straits Settlements and at the Arnhem (Holland) smelter.

The tin market has not been particularly active during the past week, and consumers' interest in new business is not substantial. The tinplate market in this country is in an unsatisfactory condition, and both home and export demand is weak. The industry is employed at slightly over 50 per cent. of capacity, or 28 per cent. less than that for the corresponding period of last year. In the United States, tinplate mills are only operating at between 30 and 35 per cent. of capacity.

Official quotations were as follow :—

Cash.—Thursday, £215 to £215 5s.; Friday, £214 to £214 5s.; Monday, £212 15s. to £213; Tuesday, £213 10s. to £213 15s.; Wednesday, £215 to £215 5s.

Three Months.—Thursday, £216 to £216 5s.; Friday, £214 15s. to £215; Monday, £213 15s. to £214; Tuesday, £214 5s. to £214 10s.; Wednesday, £215 15s. to £216.

Spelter.—Trade demand continues to be quiet, and the immediate outlook is not at all satisfactory. The market has become particularly sensitive to the selling and liquidation which has taken place. The American market has also been easier, owing to the lack of any definite stimulus.

Daily market prices :—

Ordinary.—Thursday, £13 12s. 6d.; Friday, £13 10s.; Monday, £13 5s.; Tuesday, £13 8s. 9d.; Wednesday, £13 13s. 9d.

Lead.—Demand for this metal has not been very brisk of late, as the annual stocktaking period is at hand. Consuming industries are only moderately employed, and little new business is likely to take place for some time. Speaking at the annual meeting of the Mexican Corporation on Monday, Mr. F. W. Baker said that he was not without hope that the effort to stabilise the price of lead might be followed by a similar effort to stabilise the price of zinc.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £13 13s. 9d.; Friday, £15 8s. 9d.; Monday, £15 3s. 9d.; Tuesday, £15 2s. 6d.; Wednesday, £15 2s. 6d.

Scrap.—Owing to the small amount of business available, stocks of scrap are accumulating. The export trade has fallen away, largely as the result of a decline in the demand from Germany.

Approximate selling prices for old metal:—New aluminium cuttings, £70; rolled, £54; cast, £30 to £32; foil, £80. Copper, £39 to £44; braziery, £35. Brass (clean), £21 to £24. Zinc, £10. Lead, £15. Gunmetal, £40.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Titan Foundry Company, Limited, Titan Foundry, Dumballs Road, Cardiff.—Capital £3,500. Directors: J. and O. Bowles.

Feversham Metal Company, Limited.—Capital £1,000. Subscriber: A. K. Whitburn, 31-34, Basinghall Street, London, E.C.

J. Hobkirk, Sons & Company, Limited, Kempston, Beds.—Capital £10,000. Iron and non-ferrous founders, etc. Directors: J. T. and W. T. Hobkirk.

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